

AC 4413
Surrey County Council.

MEDICAL OFFICERS OF HEALTH.

ANNUAL REPORT

1898.

WITH A REPORT ON

THE SYSTEMS

OF

SEWAGE DISPOSAL

IN THE

COUNTY,

BY THE MEDICAL OFFICER FOR THE

County of Surrey.





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I.—INTRODUCTORY LETTER.

MR. CHAIRMAN, MY LORDS AND GENTLEMEN,

I beg to submit herewith the usual Report and Summary for the past year.

The wish has been so often expressed at the Sanitary Committee that the Report and Returns should be quickly rendered (as, indeed, the Local Government Board Rules clearly require them to be), that I have made every endeavour to comply with this wish during the last three or four years.

There are now several counties which present comprehensive Annual Reports. But none relating to the year 1898 have to my knowledge as yet been published. From this it may be gathered that custom or tradition with regard to this matter is not so easily altered. Still, on behalf of my colleagues, who are late, and myself, I regret that it has not been possible to make this Report for the County of Surrey a little earlier. I desire to accept my full share of any blame in consequence of delay. I hope that the increasing care which has been bestowed on the preparation of these reports will be recognized, and that it will to some extent be held to excuse a fault which I admit and sincerely regret.

The salient points in this Annual Report have already been referred to by the Chairman of the Sanitary Committee at the meeting of the Council on May 9th, 1899.

Your obedient servant,

EDWARD C. SEATON, M.D.

County Medical Officer of Health.

*To the Council of the
Administrative County of Surrey.*

June, 1899.



ANNUAL REPORT

OF THE

MEDICAL OFFICER OF HEALTH

FOR THE

Administrative County of Surrey.

1898.

II.—RULES OF THE LOCAL GOVERNMENT BOARD AS TO ANNUAL REPORTS OF MEDICAL OFFICERS OF HEALTH.

The Annual Reports of Medical Officers of Health within the County are required by the Local Government Board to be prepared and presented to the Sanitary Authorities (Town or District Councils) as soon after the 31st of December as practicable. Where the moiety of the salaries of the Medical Officer and the Sanitary Inspector is paid from the County fund, copies of the Reports are also required to be forwarded to the Board and to the County Council. The circular signed by the Medical Officer of the Board, which is sent to every Medical Officer of Health on his appointment, sets forth a general scheme for the Report, and at the same time clearly states within what limit of time the Report should be presented. The portion of the circular referring to the time of presentation of reports is printed herewith. The rule as to time of presentation is that only in exceptional cases need it be later than **six weeks** after the close of the year.

MEMORANDUM AS TO ANNUAL REPORTS OF MEDICAL OFFICERS OF HEALTH.

“Every Medical Officer of Health, appointed under Order of the Local Government Board, is required to make an Annual Report with regard to each Sanitary District, or division of a District, which is under his superintendence. This Report is to be for the year ending the 31st of December, or, if the Officer at that date has not been in office for a whole year, then for so much of the year as has elapsed since his appointment. *The Report is to be made to the District Council, and the Medical Officer of Health himself should send a copy of it to the Local Government Board and to the County Council or County Councils of the County or Counties within which his district may be situated. It should be made as soon as practicable after the expiration of the year to which it relates. The Medical Officer of Health ought not, in general, to have any difficulty in doing this within a month or six weeks; but if from any special circumstances the Report cannot be completed within six weeks, it should be understood that the delay must not be indefinite, and that the Report should be in the hands of the District Council, and of the Board, within, at most, three months from the end of the year.* The Board’s copy of the Report should be forwarded to them when the original is sent to the District Council, except where the Report is likely to be printed by order of the District Council. In such cases the Board need only be supplied with a printed copy. It is very desirable that the Annual Report should be printed, in order that a supply of copies may be available for distribution among the District Councillors and other persons interested.”

The Circular is signed by Sir Richard T. Thorne, Chief Medical Officer of the Local Government Board.

In order to assist Medical Officers in the County in complying with this rule, and to enable them to give correct estimates of the number of deaths properly belonging to each district, lists obtained from the County Asylum, County Hospital, Joint Isolation Hospital, and some other Institutions, have been circulated by direction of the County Council.

A great deal of time is every year expended in the preparation of statistical returns, the value of which is fully appreciated by the County Council. But although certain statistical tables are essential for purposes of comparison and record, the number of extra tables or repetitions of statistics may in some cases admit of curtailment. However this may be, the presentation of tables should not delay the Report. If the printing of them be the reason for the rather late appearance of some Reports, the simple way of preventing the trouble which may arise in consequence is for the District Councils to have written and certified copies of necessary statistical returns sent to the Local Government Board and the County Council.

In this Report the statistical returns are summarised and presented in as brief and convenient a form as possible, the more copious information, which is represented by many sheets of verified figures, which are sent to the County Council, being retained for reference when required for the purposes of some special investigation.

The number of cases and deaths from the notifiable diseases are also printed as an appendix, as they are frequently required for reference by various authorities. Typhoid Fever, which is, generally speaking, due to well understood and preventable causes, is recorded separately in a way that should help to convince those chiefly concerned of their responsibility in dealing with the unwholesome condition of dwellings and their surroundings, and making safe the sources from which the water supply of the population is derived.

Further remarks on this "Chart" as an "Index" of insanitary conditions prevailing in the areas of the several District Councils will be made in the sections of the Report devoted to Statistics and Preventive Measures.

III.—ADMINISTRATION.

The work specially belonging to the County Medical Officer has been described in detail in previous Reports, the number and variety of the matters in which his advice and assistance have been required being fully set forth. Additional information has been furnished to County Councils, such as Wiltshire, who are desirous of promoting efficiency in Sanitary Administration generally. The subjects on which special advice, information, evidence, and other assistance has been given in the County, concern the following subjects:—

(a) *Water Supplies*.—The Watershed of the Wandle; Southwark and Vauxhall Bill; Haslemere and Wey Valley Bills; Reports of Analyses; Intakes of Companies; River Wey Watershed Report; Croydon, Waddon Water Scheme; Malden Rushet deficient supply; Kingston Constant Water Supply; Sutton Water Supply; Kenley Subsoil Contamination; Metropolitan Water Control Act; East Surrey Mains; Danger to river sources of certain water supplies from encampments of Gipsies at Walton Bridge, near Intake West Surrey Company; Special Communications with Medical Officers of Health as to their responsibilities, and those of Analysts, in reporting on Water Supplies.

(b) *Sewage Disposal and River Pollution*.—Completion of Godalming Connections; Summersbury Interception Work; River Pollution at Salford; Oxted Drainage Inquiry; the Capel Village Pollution; Sutton and the Pylbrook; the Catteshall Paper Mills; Carshalton Scheme; Croydon, Wandle Complaints;

the Cleansing of the Bed of the Blackwater; Area and Jurisdiction of the Thames Conservancy Board; Standards of Purity for Effluents; General Inquiry as to Working of Sewage Disposal Systems.

(c) *Vaccination*.—Numerous Meetings of Medical Officers of Health with reference to the provisions of the New Act, and its probable effect; Sanitary Committee Leaflets.

(d) *Hospitals*.—Dorking Joint Committee; Reigate; Farnham.

(e) *Notification*.—Discussion of the Act 1889, at the Society of Medical Officers of Health; proposed Amendments.

(f) *Outbreaks*.—Diphtheria at Esher, Sutton and Caterham; Typhoid at Shalford and Earlswood; Reports of Closure of various Elementary Schools on account of Measles, Whooping Cough, and Scarlet Fever.

(g) *General*.—Cremation; County Laboratory; Mitcham, Housing Working Classes, County Council Inquiry; Reigate, Sanitary Inspector's Reports on Slaughter Houses; Egham, Closing Order for Houses, Englefield Green; the Beverley Brook Nuisance.

LOCAL GOVERNMENT BOARD INQUIRIES.

Oxted (Mr. Wilcocks), January 26-27.—Continuation of Inquiry from November, 1897.

New Malden (Mr. Meade King), March 22.—Sewerage, &c.; loan £4550.

Horley, Reigate (Col. Langton Coke), April 5.—Sewerage, &c.; loan £810.

Westcott, Dorking (Col. Langton Coke), April 5-12.—Provisional Order (Sewage Disposal).

Reigate (Mr. Tulloch), May 17.—Sewerage, &c. ; loan £3800.

Weybridge (Col. Albert Smith).—Surface Water Drainage ; small Loan.

Epsom (Mr. Wilcocks), July 5.—Sewerage Extension ; small Loan.

Ewell (Mr. Wilcocks), July 4 and 28.—Sewerage, &c. ; loan £17,000.

Croydon (Mr. Wilcocks and Dr. Wheaton), July 25, 26, 27, August 1.—Sinking Well at Waddon ; loan £32,000.

Cobham (Mr. Ducat), August 26.—Sewerage, &c. ; loan £22,000.

Nutfield (Mr. Ducat), September 13.—Sewage Disposal ; loan £1000.

Sutton (Mr. Bicknell), October 18.—Sewage Disposal ; loan £1600.

Carshalton (Mr. Law), November 1.—Sewerage, &c. ; loan £10,000.

Purley (Mr. Law), November 2.—Sewerage, &c. ; loan £14,000.

Sanderstead (Mr. Law), November 3.—Sewerage, &c. ; loan £1300.

Richmond (Mr. Meade King), December 19.—Depot Work ; loan £750.

Guildford (Col. Langton Coke and Dr. Sweeting), December 20.—Sewage Disposal ; loan £2700.

Leatherhead and Ashted, December 30.—Sewerage and Sewage Disposal ; loan £43,000.

COUNTY COUNCIL INQUIRY.

Mitcham (Mr. Welch), December 14.—Housing Working Classes Act, 1890, Sec. 55.

TABLE A (Rural Districts), 1898.—Birth-rate, Death-rates from all Causes, from the principal Zymotic Diseases, and from Diseases of the Respiratory Organs, and Infant Mortality.

Rural District.	Population.	Births.	Deaths.	Birth-rate to 1000 persons living.	DEATH-RATES TO 1000 PERSONS LIVING.				Deaths of Infants under one year to 1000 Births.
					All Causes.	Principal Zymotic Diseases.	Phthisis.	Respiratory Diseases.	
Chertsey ...	11,000	291	125	26·5	11·4	1·0	0·9	1·4	92
Egham ...	10,800	276	147	25·5	13·6	2·7	0·9	2·2	141
Farnham ...	14,000	452	220	32·0	16·0	1·3	0·9	3·4	113
Hambledon ...	21,500	504	275	23·4	12·8	2·6	1·1	2·1	79
Guildford ...	22,000	460	270	21·0	12·2	0·9	1·0	1·6	130
Dorking ...	10,870	200	134	18·4	12·3	0·8	1·4	1·7	75
Epsom ...	16,810	412	212	24·5	12·6	1·1	0·9	2·5	82
Croydon ...	28,717	790	398	27·5	13·9	2·7	0·9	2·2	149
Reigate ...	16,600	373	196	22·4	11·8	1·2	0·9	1·6	75
Godstone* ...	21,351	616	464	28·8	12·6	0·7	1·1	2·7	120
Total of above Districts	173648	4374	2441	25·3	14·0	1·5	1·1	2·3	113

NOTE.—Corrections have been made for Public Institutions.

TABLE A (Urban Districts), 1898.—Birth-rate, Death-rates from all Causes, from the principal Zymotic Diseases, and from Diseases of the Respiratory Organs, and Infant Mortality.

Urban District.	Population.	Births.	Deaths.	Birth-rate to 1000 persons living.	DEATH-RATES TO 1000 PERSONS LIVING.				Deaths of Infants under one year to 1000 Births.
					All Causes.	Principal Zymotic Diseases.	Phthisis.	Respiratory Diseases.	
Barnes ...	17,300	351	187	20·3	10·8	2·0	0·5	1·4	182
Richmond ...	31,000	663	443	21·4	14·3	1·0	1·1	3·0	170
Wimbledon ...	38,000	963	442	25·0	11·6	2·0	0·5	1·5	150
Ham... ..	1,620	30	22	18·5	13·5	3·0	2·5	2·5	136
Kingston ...	34,000	960	476	28·2	14·0	2·6	1·1	2·1	153
Esher and Dittons ...	9,000	226	104	25·0	11·9	1·7	1·2	1·9	93
The Maldens & Coombe	6,000	138	60	23·0	10·0	1·3	0·2	1·0	160
Surbiton ...	13,000	311	174	24·0	13·4	0·9	1·2	1·2	128
East & West Molesey	6,300	161	82	25·5	13·0	2·5	0·5	1·3	143
Chertsey ...	12,800	306	159	23·9	12·4	2·1	1·5	2·1	128
Weybridge ...	4,900	119	53	24·2	10·8	1·0	0·8	2·4	85
Walton ...	9,000	233	102	25·9	11·3	1·9	0·9	2·3	103
Farnham ...	5,950	118	80	20·0	13·6	1·3	2·3	3·0	127
Frimley ..	6,476	181	68	28·0	10·5	1·4	0·8	0·9	127
Godalming ...	9,000	124	110	13·6	10·0	1·1	0·4	2·0	200
Guildford ..	16,485	380	238	23·0	14·7	1·8	1·3	2·3	137
Woking ...	12,700	372	162	29·0	12·8	1·9	2·0	1·7	126
Dorking ...	7,800	164	139	21·0	17·8	2·0	0·5	4·0	190
Leatherhead...	4,900	113	60	23·1	12·2	1·2	1·2	1·2	160
Epsom ...	9,200	223	133	24·2	14·4	1·5	0·6	3·2	135
Sutton ...	14,600	324	175	22·2	11·3	1·9	1·2	1·6	135
Carshalton ...	6,300	169	79	27·0	12·5	1·9	0·4	1·7	166
Reigate ...	24,800	545	347	21·8	14·0	2·5	1·4	1·8	128
Total of above Districts	301131	7174	3895	23·9	12·9	1·8	0·9	1·7	130

NOTE.—Corrections have been made for Public Institutions.



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CHANGE IN APPOINTMENTS OF MEDICAL OFFICERS OF HEALTH
AND SANITARY INSPECTORS.

Dr. Darra Mair, Medical Officer of Health for Croydon Rural District, has had the honour of being selected as a member of the Medical Staff of the Local Government Board. Dr. Fegen has now been appointed by the Rural District Council to the vacant office. The excellent system of administration in this district has been commended in the Annual Reports of the County. The County Medical Officer of Health has given his best advice and assistance in the establishment of the system. He has been gratified by receiving letters acknowledging that assistance at various times.

Dr. J. J. Knox died at the close of the year. It is with great regret that the loss of so promising a member of the profession is here recorded. He is succeeded in the post of Medical Officer of Health by his brother, Dr. James E. Knox.

At Woking, the office of Sanitary Inspector has at length been dissociated from that of Surveyor. Mr. Ablett has been appointed to the first-named office.

IV.—COUNTY STATISTICS.

In England the census is taken only once in every ten years, the date of the last one being April, 1891. By the Registrar-General's method the population of a district is calculated on the assumption that rates of increase or decrease continue during the intercensal period at the same rate as that shown by comparing the figures of the last census with those of the census before. But during the long period of ten years, changes in local circumstances frequently take place which sometimes cause the estimates to be very wide of the mark when the time for reckoning the population comes round. Consequently it is often urged that in order to reduce the limits of error in calculations, a census should be held at shorter intervals, say once in every five years. It is to be hoped this will be arranged for before 1901, as in the case of some districts within the County the birth-rates and death-rates, calculated on the usual official system, cannot be correctly stated. In the meanwhile attention may be directed to local estimates by Medical Officers of Health who have the opportunity of observation, and who take into account the number of children born since the last census, and the number of houses which they have seen erected and occupied since then. Noteworthy corrections have been made in this way for the populations of the Woking and Godstone (now with Lingfield) districts. In these instances, after conference and inquiry with the Medical Officers of Health, the local estimates have been preferred to those arrived at by the established official method, although as a general rule that system is acknowledged to be the best, and should of course be adhered to unless the circumstances are very exceptional.

The Population of the Administrative County for 1898, estimated in the usual way (with the above-mentioned slight correction), and allowing for public institutions, was in round numbers 475,000.

The Births numbered 11,548. Consequently the number of births per 1000 persons living, or the birth-rate, was 24·3. This figure is lower than the average for the preceding nine years.

The Deaths numbered 6336. Consequently the number of deaths per 1000 persons living, or the death-rate was 13·3. This is above the average of the two years 1896-7, but slightly below the average of the seven years 1889-95, which was 13·6.

The death-rate of the Rural Districts was 14·0, and that of the Urban Districts 12·9.

Those who are familiar with the Local Government system understand of course the real significance of these terms "Rural" and "Urban." They refer to the powers vested in the District Council or governing authority, and do not necessarily convey any description of the district. Without this information it would be puzzling to account for apparent anomalies in the grouping of the districts. Croydon, which includes the populous and, in many parts, closely-built districts of Mitcham and Merton, is grouped with the Rural Districts, whereas such places as Farnham, Weybridge and Woking are called "Urban." In comparing the death-rates of towns, one of the first considerations is the "density of the population," that is to say, the number of persons per acre. Other things being equal, there is a tendency for the death-rate to increase directly in proportion to the density of the population, owing to the proximity of dwellings and the greater risk of spreading

diseases. But except in the case of London and some of the very large towns, the ordinary test of the density of the population, which is arrived at by dividing the population by the number of acres belonging to the Borough or District, is apt to be misleading. The areas of local government are of every variety of shape and size, and it often happens that the population, instead of being diffused throughout, is aggregated in a comparatively small section. This is generally the case in Surrey, and consequently the density of the population, estimated in the ordinary way, serves only in a few instances, such as Kingston, to indicate the sanitary conditions that might be expected. For example, a glance at the Map of the Urban and Rural Districts of the County, published in the Report for 1897, shows a comparatively large area belonging to Leatherhead, but the populated portion is relatively small, consisting of a small area covered with houses built rather close together. So that density of population cannot be fully considered in relation to the death-rates in the Urban Districts. Neither can it be taken into much account in discussing the causes of mortality in the Rural Districts, although it will be presently observed, in connection with the Typhoid Chart, that the country round Dorking, which has the most favourable return, is at the same time the most thinly populated district in Surrey.

One of the most significant columns of the Table which accompanies this part of the Report is that which relates to deaths of infants under one year of age. This, be it specially observed, is estimated in relation to the births of the year under notice, and the calculations are independent of any fallacy which may be due to an under-or over-estimation of the population for the time being. On former occasions attention has been called with good results to the districts which show

rates of 150 and upwards. They include the large towns of Richmond with Barnes, Wimbledon, and Kingston, together with the smaller districts of Malden, Dorking, Godalming, Leatherhead, and Carshalton. The records of the Registrar-General, published year after year, show that in certain manufacturing districts of England the average Infant Mortality is as high as 170-180. This excessive death-rate is attributed to the absence of maternal care resulting from the engagement of child-bearing women in factory work. In some instances the death-rate of towns has been observed to stand still and even to rise in spite of the generally improving sanitary circumstances. Careful investigation in such cases has shown that a considerable fall in the death-rate of adults has synchronised with a marked rise in the infant death-rate, the whole result being expressed by a nearly stationary death-rate when all ages are included. The conditions of life are of course very different in the manufacturing towns to those prevailing in the South of England, and, therefore, reasons of this kind can not be said to apply to the populations of Richmond and Kingston. The subject is clearly one for thorough local investigation and report.

The column of "Infant Death-rates" is in close connection, and should be "read into" those headed respectively "Zymotic" and "Respiratory" diseases. It frequently happens that the autumn epidemic of Diarrhoea (*Cholera Infantum*) is fatal from want of early attention to cases. And the same is true with Measles, Whooping, and that illness which assumes such protean forms—Influenza. Indeed, in the case of Measles, the forecast depends chiefly on the character of the house accommodation, medical attention, and skill in

nursing. It is in this way that the troublesome after effects, the most dangerous of which is inflammation of the lungs, are averted. When the illness occurs in crowded tenements and ill-ventilated dwellings, the risk to the lives and future health of the sufferers, as well as of the spread of the infection, is at its maximum. It is a boon to the sick and a benefit to the public health that they should be removed to comfortable well-managed hospitals. In these Reports the advantage of establishing hospitals, especially in those districts where the want of decent dwelling accommodation is shown by the overcrowded state of the cottages, has been dwelt upon.

The Respiratory diseases column will also furnish supplementary information with regard to Phthisis, or Consumption, as to the causes of which much has been done to enlighten the public. In many cases Tuberculosis gives rise to slow processes of inflammation of the lungs, and death is certified as due to Pneumonia. In the Report for 1897 occur the following remarks:—

“The most satisfactory feature in the returns for the whole County is the low death-rate from Phthisis, *i.e.*, pulmonary consumption (under 1 per 1000 population). The connection of the prevalence of this disease with conditions of the soil is matter of great medical interest. The Phthisis death-rate in Surrey is low as compared with Kent, Sussex, and Hampshire, slightly under 1 per 1000 population. It is only by taking a number of years in succession for comparison that it is possible to draw any conclusion with regard to immunity of particular districts in the County.”

“In connection with the prevalence of Phthisis and tuberculous diseases generally, the supervision of cowsheds is of the first importance.”

A death-rate of 1 in 1000 (which is exceeded in 14 districts) represents nearly 500 deaths every year. This is about ten times the annual mortality due to "Fever" (Typhus and Enteric, more commonly known as Typhoid Fever) in the County of Surrey. The attention given in official reports to Typhoid as compared to Consumption would seem to be in inverse proportion to their influence on the death-rate. But in reality the root of the mischief with Consumption is struck at in banishing the causes of Typhus and Typhoid. Dark and ill-ventilated dwellings, such as were formerly common, enabled Typhus to flourish, and at the same time favoured the development of Consumption. Foul and insufficient water supplies, accumulations of filth and want of proper drainage, both for towns and houses, propagated Typhoid, and maintained Consumption prevalence at a high rate. In lowering the subsoil water of towns and in thus rendering the foundations of houses drier and cleaner, the conditions which enable Typhoid to exist have been removed, while at the same time the prevalence of Consumption has been markedly reduced. If the Typhoid death-rate should in a few more years be brought almost to the vanishing point, it is safe to predict that Consumption will tend to disappear with it. There is analogy between these two diseases in other respects besides those which may be designated "sanitary circumstances," for both are infectious in their own peculiar and special ways. In recognition of this fact, and with a view to assist in removing the cause of so much sad and lingering illness, the Sanitary Committee and the County Council, towards the close of the year under notice, resolved to print leaflets on the subject of the prevention of Consumption for the use of District and Parochial Councils.

V.—PREVENTIVE MEASURES.

Vaccination.—The preventive measure which has received the largest amount of attention at the hands of Sanitary Authorities and Medical Officers of Health during the year under notice has been Vaccination. The County Medical Officer of Health has been called upon to preside over, or take part in, discussions at special meetings convened by the Society of Medical Officers of Health, on whose behalf he also signed a document setting forth the opinion of Medical Officers of Health throughout the Kingdom, as to the necessity of Vaccination, and the great danger to the public health which would be involved by any extensive relaxation of the compulsory law, under the present conditions.

It is too soon to attempt any estimate as yet of the effect of the New Vaccination Act, but some of the reports show that Medical Officers view with dismay the possibility of a large number of unprotected persons growing up in their districts, especially as they are entirely without any means of hospital isolation.

Lord Lister has spoken of the “tremendous experiment” which is now being made with regard to Smallpox and Vaccination. There is one point in connection therewith which is of vital importance, and which, although it is understood by experts, is not so fully appreciated by the public, and is seldom referred to in public reports or debates. It is the quality or amount of the Vaccination, and the degree of protection afforded thereby. This was to a considerable extent guaranteed by the old arm-to-arm system at public Vaccination stations. It has yet to be seen how the new system will work in this respect. It is

greatly to be desired that some public record should exist of the way in which Vaccination has been performed in every case. It would then be possible, in the event of a Smallpox epidemic, to distinguish not only between the vaccinated and unvaccinated, but between the sufficiently and insufficiently Vaccinated.

The Medical Officer of Health for Surbiton, Owen Coleman, M.D., D.P.H., has made an important report to his Council on this aspect of the Vaccination Question. The County Medical Officer of Health is substantially in agreement with Dr. Coleman, and desires to emphasize the following remarks:—

“Every qualified medical man is instructed in Vaccination, and knows what is required of him to vaccinate successfully and efficiently. Nevertheless, to make the matter as certain as can be, the Government, acting on the best medical knowledge and experience, has in the Local Government Board Orders distinctly laid down how Vaccination ought to be performed, and if it is to be performed properly it must be done in that way. It says: ‘The Public Vaccinator must aim at producing four separate good-sized vesicles or group of vesicles not less than half an inch from one another.’ This makes it obligatory on him (the Public Vaccinator) to vaccinate in that way and to that extent, and by such means, if the result is successful, the child is protected against Smallpox for a certain period. The medical man, other than the Public Vaccinator, generally follows with the same rules and vaccinates his cases similarly, and with probably equally good results. But there are everywhere some exceptions, and throughout the country there are some practitioners—fortunately a small minority—who, yielding to the prejudices and fears of their patients, will vaccinate in one

or two places, often in only one instead of four. These doctors assist very materially in bringing discredit on vaccination, in the eyes of the ignorant and unthinking, as a protective against Smallpox. A child so imperfectly vaccinated is *not* efficiently protected, but goes out into the world as if it were, and later on possibly contracts the disease and appears in the returns, amongst numbers of similar cases, as ‘having contracted Smallpox though successfully vaccinated.’ ”

From the Public Health point of view the outspoken remarks of so experienced a practitioner and official as Dr. Coleman are valuable and opportune.

Smallpox Isolation.—The movement to provide means for efficiently isolating first cases of Smallpox outbreaks is progressing, though necessarily very slowly. The Guildford Joint Hospital Board took up this question in 1894 quite independently on account of the urgent need which they experienced of means for treating Smallpox apart from other cases. Great credit is due to them for the persevering manner in which they have pursued their object. The opposition was continued, though unsuccessfully, to the very last, as is shown by the following extracts from the Report of Surgeon-Major Wellington-Lake, the Medical Officer for the Joint Board :—

“After a good deal of litigation since the selection of the site, a tender for £4795, by Mr. Alfred Johnson, builder, of Guildford, was accepted and sealed for the erection of a Smallpox Hospital, on Whitmoor Common, Worplesdon.

“The work was progressing favourably till December, when an application was made in the High Court, by Mr. R. Garton

and others in the neighbourhood, for an injunction to restrain the Joint Board from injuring the turf on the approach to the site in carting the building materials thereto."

By this means accommodation will be afforded for a part of West Surrey, containing a population of about 50,000 persons, but the greater part of the district remains unprovided for. Medical Officers of Health are naturally the strongest advocates of Vaccination; but their advocacy in this respect does not make them blind to the absolute necessity for proper means of isolation as a supplementary preventive measure.

The necessity for Isolation Hospitals for Diphtheria, Typhoid Fever, Scarlet Fever, and Measles, is continually being impressed on District Councils. Two such hospitals have been completed in the year under notice.

The Medical Officer for the Farnham Joint Hospital District reports as follows :—

"Early in May the temporary Isolation Hospital, erected by the Isolation Hospital Committee, was ready for use, and up to the 1st of January, when the permanent Hospital was opened, was, with the exception of a week or two, constantly occupied, showing how necessary it was to provide accommodation without delay.

"Up to the end of the year 28 cases were admitted from the Rural and the Urban Districts, and of these 14 were from the Rural District; 11 cases of Scarlet Fever and 3 of Diphtheria.

"I have previously referred to the absolute advantage gained by the prompt isolation of these cases in preventing the spread of disease, and it is gratifying that up to the present time, although in all 34 cases have been treated in the Hospital,

there has been no fatal case, and that the parents of the patients and the adult patients themselves have expressed themselves as grateful for the care taken of them.

“The Hospital as it now stands contains 30 beds and 4 cots, but supposing a severe epidemic were to arise, the cubic space at our disposal would safely enable us to accommodate more without any detriment to the patients themselves, whilst the ample accommodation provided in the Administrative Block is sufficient to accommodate a full staff of nurses requisite for any emergency. We are also in a position to deal with three different diseases simultaneously.

“As an Isolation Hospital I should consider the Farnham Hospital second to none in the County. I consider the joint Councils are heartily to be congratulated on possessing the same, and I am quite sure the joint populations will reap the most valuable advantages and protection from it in the years to come.

“I venture to think that in no other sanitary area of the County of Surrey has such progress been made as there has been in ours in the year 1898, viz., the establishment of a good water supply, the completion of the Isolation Hospital, and lastly the starting of an urgently wanted scheme of Scavenging for a portion of the District.”

The Croydon Rural District Council has also completed its Hospital, situate at Beddington Corner. An account of this building will be given in a subsequent Report. In the meanwhile it is gratifying to record the friendly relations between the Croydon Corporation and the Authority for the part of the Administrative County adjacent to the Borough.

Dr. Fegen reports as follows :—

“ During the past year cases of Diphtheria, Scarlet Fever and Typhoid Fever have been admitted into the Croydon Borough Hospital, under an arrangement with the Croydon Corporation, from the District. Towards the latter part of the year, however, room could not be found for any more Scarlet Fever patients. The attention and kindness which the patients received while in the Borough Hospital have given the greatest satisfaction to patients and parents alike.

“ The routine preventative and precautionary measures have been continued as heretofore, involving repeated visits to infected houses and the advising of the best means of procuring isolation and preventing the spread of disease. Enquiries are made and recorded in every case of notifiable disease, and immediate notice is sent to any school attended by children from infected houses. Disinfection of the infected rooms by fumigation with sulphur dioxide, and of the bedding and clothes by steam, is carried out by the officers of the Council.

“ The disinfection by steam has been most efficiently carried out at the Workhouse, by arrangement with the Guardians, and has undoubtedly proved most beneficial in every way to the District. In the near future it will be necessary for the Council to consider the advisability of disinfecting the room and bedding in cases of deaths from Phthisis, as the tubercle bacillus is long-lived and capable of spreading the dread malady of Consumption. An agitation is going forward at the present time to include Phthisis in the list of notifiable diseases, but if this was insisted upon it would materially tend to defeat its own object.

“In cases of Diphtheria the custom is not to relax the precautions taken until such time as the bacteriological examination shows the throat to be free from either the true or pseudo-bacillus of Diphtheria.

“In cases of Typhoid Fever sanitary pails of a special shape are delivered every alternate day at the infected houses for the reception of all *excreta* and other waste products of the sick room, and the contents are burned at the sewage works. Undoubtedly this is quite the best way of getting rid of Typhoid *dejecta* and far preferable to the old ways of either turning them into the sewer, or, where no sewer exists, burying them in the garden, as the Typhoid bacillus may exist for a sufficiently long period as to gain access to wells or other supplies of drinking water and so produce an epidemic.”

The Medical Officers of Health for Barnes, with Richmond, are also able to report progress.

Dr. Adams writes :—

“I am pleased to be able to say that the addition to the hospital has been completed, and is in every particular satisfactory, and quite equal to our requirements. It does great credit to our Surveyor, who has been most indefatigable in supervising the work. We have already found it very useful, and it is a great relief to feel that we are not cramped for room. I hope it will be equal to our requirements for many years.”

Dr. Donald writes :—“An important sanitary event has occurred during the year. It has been the arrangement enabling cases of *infectious disease occurring at Ham* to be sent to the *Tolworth Infectious Hospital*.”

Dr. Rowland writes:—"The valuable assistance of the new Isolation Hospital is now available (the institution having been open for the reception of patients for many months), where there is also a powerful modern disinfecting apparatus for purifying bedding and other articles liable to retain infection."

Several Medical Officers of Health comment on the absence of isolation hospital provision, and on the slow manner in which their establishment is proceeding.

Dr. Pocklington, Medical Officer of Health for Wimbledon, writes:—"Sixty cases were notified during the year, and six deaths. The great increase of Diphtheria in its prevalence and fatality is a matter of serious importance. An increase has taken place in the Metropolis and Suburbs generally, but not quite to the same extent as in Wimbledon. Undoubtedly the absence of hospital accommodation partly accounts for this increase, as it necessitates the patients being kept at home, where in most cases the means of isolation are of the poorest; thus in many instances the cases become a centre of infection.

"I trust the building of the New Isolation Hospital will be pushed on with all speed. The advantages of an Infectious Hospital are great, not only on account of difficulties existing in the way of isolation in private houses, but also because the serum treatment is there more readily resorted to than is possible in private practice."

Continuing, he says with regard to Diphtheria:—

"In only a few cases, so far as I can ascertain, has a bacteriological examination been made. In the future I hope more

use may be made of the means provided by the Council for verification of diagnosis in doubtful cases. This is an important matter, inasmuch as infectious cases are liable to be overlooked, and become unsuspected centres of infection."

With regard to Measles, he writes:—"The Local Government Board sanctioned the inclusion of Measles in the list of notifiable infectious diseases for a limited period, which extension came into force on June 27th last."

With regard to the provision of special Smallpox Hospital accommodation, he writes:—"A suggestion made by the Corporation of Croydon for the formation of a Joint (Smallpox) Hospital Board for the Borough of Croydon, the Rural District of Croydon, and the Urban District of Wimbledon, was approved by the Council, on the understanding that the Council's representation on the Joint Board shall consist of three elected representatives out of twelve, and one ex-officio representative out of three."

"A Local Government Inquiry was held at the Croydon Town Hall on the subject."

The entire absence of any provision whatever for isolation, and its serious consequences in thickly-populated towns and in the overcrowded houses of Rural Districts, should be kept steadily before the District Councils concerned. The Medical Officer of Health for Kingston has never failed to do this in his Annual Reports. The following is from his Report for 1898:—

"In nearly every case of Typhoid Fever and Diphtheria that is brought to my notice, the need of an isolation hospital becomes impressed upon me. In a considerable number of

the homes in this town, when cases of these diseases occur the patient is placed on a couch in the sitting room or kitchen, and receives as much attention as the mother can spare from the time needed for her household duties. When there are many children in the household they are tramping in and out of the house all day long, for owing to the infection, they are excluded from school. In some cases, owing to the impossibility of proper isolation, the disease is spread. Last year two children contracted Typhoid from their mother, and in cases of Diphtheria there have been numerous instances. We must, in considering this question, look at the position of the sufferer. A person with Typhoid Fever wants constant nursing night and day, scrupulous cleanliness, careful dieting, and rest, and none of these could possibly be obtained in the great majority of cases of this disease occurring in the Borough. Two lives have been lost during this year from the want of some necessities. One was a young child, with whom the disease is rarely fatal, and both would, in all human probability, be alive now could they have been removed promptly to a well-appointed hospital.

“Up till quite recently it has been possible to remove such cases to Richmond General Hospital, but since the opening of the Richmond Isolation Hospital, the General Hospital has declined to receive patients applying for admission. I understand that the Kingston Victoria Hospital will not admit such cases, so that the alternatives for these cases is the provision of an isolation hospital, or an unnecessary mortality.”

It is a very remarkable thing that Kingston is the only important District in or near South London in which the necessity for an Isolation Hospital is unrecognized.

In several of the Reports the serum treatment of Diphtheria and bacteriological diagnosis of all kinds is referred to. The subject is of growing importance to Sanitary and Hospital Authorities. Probably the Sanitary Committee of the County Council will desire a special investigation and Report by the County Medical Officer of Health on the subject.

Preventive measures, apart from structural provision for isolation and disinfection, include vigilance and intelligent inquiry by skilled medical officers into the origin and spread of outbreaks. Evidence of the value of this work is in the nature of things difficult to furnish, but it stands to reason that by tracing the connection of one case of illness with another, and stopping channels of infection, Medical Officers of Health are fulfilling one of the principal intentions of their appointment. It has been urged in the Reports of the County Medical Officer of Health that freedom from "private practice" tends to facilitate this necessary work. In this respect the Medical Officers of Health for the United Districts, for Croydon Rural, and for Kingston, are advantageously situated. But occasionally excellent service is rendered by gentlemen who are very busily engaged in ordinary consulting medical practice. The Annual Reports of Dr. Oldman, the Medical Officer of Health for the extensive Godstone District, are uniformly good in this respect. His accounts of outbreaks are lucid and practical, showing exactly how they arose, and by what means they may be prevented. Such reports are most useful educationally and deserve the careful study of all who are concerned in preventing the spread of epidemic diseases by reasonable and suitable measures of precaution.

A few typical examples of the inquiries now referred to are taken from the respective Annual Reports of Medical Officers of Health to District Councils.

In a description of outbreaks, traceable to insanitary conditions, Dr. Oldman writes:—“Reviewing the circumstances attending the occurrence of these cases of Diphtheria, one would expect to find some one source of origin and vehicle of contagion which would be common to all the first cases in each group, and then the subsequent extension to other members being simple enough under the conditions in which they were living, the prevalence of the disease would be readily explained. The most common means by which infection is transmitted in such outbreaks are school attendance, milk supply, and occasions upon which people congregate in numbers, such as at church, chapel, their Sunday schools, or at places of amusement; but none of these methods were operative here. Taking school attendance first, in the Group A, amongst which the earliest cases occurred, there was no child of school age; and in Group B, only two children, who both fell ill subsequently to their brother Walter W——, aged 15, who had been engaged at work with a contractor.

“The school was closed also for the Christmas holidays from December 24th to January 3rd. The only other two children of school age were Arthur and Gladys, low down in the series, but it so happened that the latter had not attended for more than a week before falling ill. School attendance may therefore be considered to have had no influence.

“The milk supply, which may conceivably be a vehicle of contagion, can also be shown to have had no influence. Milk

is supplied to the public in Bletchingley by two dealers, and both delivered milk to the houses invaded. Besides which, the usual characteristics of the spread of infectious disease by the agency of a public milk supply were conspicuously absent, such as the simultaneous falling ill of a large number of the chief consumers of milk—namely, young children—in an equally large number of separate houses.

“As regards the other means mentioned, attendance at church, chapel, their Sunday school, or at places of amusement, these had no influence, inasmuch as the sufferers belonged to both denominations, and the same objections apply to their Sunday schools as the daily elementary school alluded to above, neither were there any public entertainments going on at the time. Finally, I would add that only in the cases of Group A was the diagnosis confirmed by bacteriological analysis.

“The measures adopted with a view to checking the spread of the disease were instructions as to such isolation as the invaded houses were capable of, in the absence of a hospital to which first cases could be removed, and a liberal supply of disinfectants. The nuisances found to exist were at once dealt with, a scheme of drainage for the district known as Barfields is under preparation by a committee of the Council, and the East Surrey Water Company have been invited to extend their mains to the same area, which has been done, and the usual notices served upon the owners to connect therewith.*

“It will be noticed that overcrowding of inmates of houses was a potential factor in the outbreaks both at Bletchingley and Caterham, and, I fear such largely prevails throughout the district. It is a difficult matter to deal with, considering the

* The nuisances described in the Report were due to very defective drainage and gross overcrowding.

scarcity of cottages, without the assistance of Part III. of the Housing of the Working Classes Act, 1890, which has not yet been adopted, but which was pressed upon the attention of the Council in my Annual Report of 1895.

“Diphtheria was also prevalent amongst the troops in the barracks in October and November, but was unknown to me until the medical officer in charge, who resides outside, fell ill with the disease, and was notified accordingly. The barracks being exempt from the liabilities under the Infectious Diseases Notification Act, the authorities are under no obligation to notify any such illness; hence the reason for the outbreak not being known to me.”

Surgeon-Major Wellington Lake, relating the facts about an outbreak of Typhoid at Worplesdon, writes:—“There were 6 cases notified during the year, and the patients resided in the same cottage, on a Common in the parish of Worplesdon, and were all members of the same family, and included the mother aged 43 years, and daughter aged 8, and four sons aged 25, 16 and 13 respectively; one son, aged 13, and the first patient attacked, was removed to the Royal Surrey County Hospital, and died there; the rest of the family were removed to the isolation hospital, and the second patient attacked, also a son, aged 10, died as well as the daughter.

“The outbreak was a remarkable one. The family, who were poor and of the agricultural labourers class, resided in a small old-fashioned farm house, very healthily situated on the Common just alluded to, and practically isolated. The initial attack was difficult to account for, but there was no doubt as to the cause of the remaining five. The only clue as to the first case was that the lad, aged 13, accompanied by an

elder, aged 18, and who was not attacked, went down on Christmas Eve, 1897, to the fair going on in the town, and indulged in some oysters, whelks, and cockles sold on the familiar portable stalls. The elder lad said he thought these molluscs were tainted, and spat out two or three without swallowing any ; but the younger lad, informing his brother that they only wanted plenty of vinegar and pepper, partook freely of them. It is a significant fact that this latter lad was notified on January 8th, 1898, just twenty-two days afterwards. I could not trace the vendor who had his barrow-stall just outside the market, and was of the itinerant class.

“ As to the other cases, it is scarcely credible, but nevertheless a fact, that the very day before the initial case was notified the excreta were carelessly thrown by the little daughter, together with the other slops, on to the grass just outside the front door, where the well, a shallow one, was situated, and which was open at the time. As a matter of routine the water was analyzed just after the receipt of the notification, and actually the specific bacilli (*B. typh.* and *coli.*) were found. The sequence of this remarkable accident was that the next boy, aged 10, failed with the fever on the 27th of the same month, that is, twenty days after drinking the water, and the next, aged 8, on the 29th, and the other three persons immediately afterwards, having drank the water a little later. The well was, of course, closed directly the first facts were ascertained, and subsequently a supply was laid on from the Water Company's mains, which were fortunately within reasonable distance.”

Dr. Lake is again able to report a freedom from Diphtheria at Pirbright. It is only right to mention this as bearing on the value of such work as he is constantly engaged upon, and

as probably affording evidence of the great advantage of school inspection for purposes of preventing the spread of Diphtheria.

Dr. Jacob writes as to *Diphtheria* in Dorking Town:—"As will be seen on reference to the preceding table, this disease was more or less prevalent in the district during the greater part of the year. Altogether there were 44 cases in thirty houses with 5 deaths.

"Five of the infected houses were in Rothes Road, 4 were in Orchard Road, 3 were in Mount Street, 2 were in Church Street, and the remaining sixteen houses were in sixteen other streets, in various parts of the town. Nearly all of them were small cottages. In one house there were 5 cases; in another there were 4 cases; in a third there were 3 cases; five houses had each 2 cases, and the remaining houses had each 1 case. Only nine of the patients were over 11 years of age. Four of the five who died from the disease were under 5 years of age. At very few of the houses were there any structural defects of the drains and closets which might be considered to have contributed to the spread of the disease. Unfortunately, owing to the long drought, the public water-supply ran short at one time and the drains or closets at many of the houses in the town were for some considerable time not flushed so well as usual, but at the time when the disease was most prevalent, viz., in September and October, this defect had been remedied. At the beginning of October the disease was found to have been spreading almost exclusively among the children attending the National Infant School, and this School was then closed, by my advice, for a month, apparently with good effect. At no time were there grounds for thinking that milk-infection was playing any part.

in causing the disease. A bacteriological examination of the mucus on the fauces of 12 of the patients was made, at the expense of the District Council, either as an aid to diagnosis in doubtful cases or to assist in deciding whether the convalescent patients were free from infection. In some houses the first cases were thought to be only 'Quinsy,' and no precautions were taken till undoubted cases of Diphtheria had appeared in the family."

It has been the duty of the County Medical Officer of Health in commenting upon the District Reports for the information of the Council, to draw attention to the minute care with which Dr. Jacob, the well-known medical officer for several districts in Surrey, makes inquiry as to sources of infection in cases notified to him. This is especially valuable in the case of so preventable a disease as Typhoid. The following examples from the reports for 1898 show that notes are taken on the following points, viz., situation of premises, dates of attacks, persons attacked, probable source of infection, laboratory diagnosis, &c.

CHERTSEY URBAN.

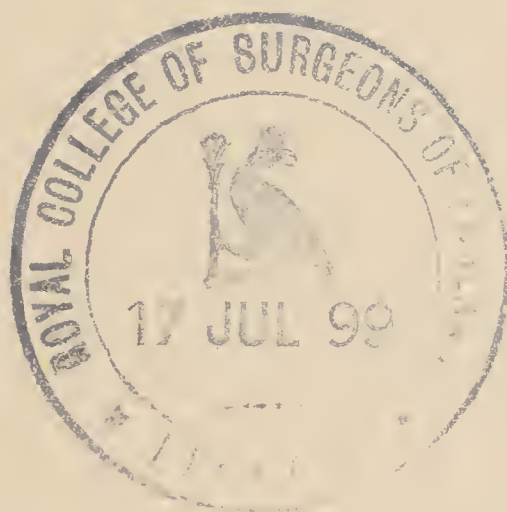
Situation of Premises.	Dates of Attacks.	Persons Attacked.	Probable Source of Infection.	Other Remarks.
Windsor Street, Chertsey	1897 Dec. 21st	Woman	London	Diagnosis confirmed by the Widal test. No local defect discovered. Water from local well, which was afterwards abandoned.
Flemish Fields, Chertsey	1898 Jan. 4th	Man	Out of the district	He failed nine days after commencing to reside here. Reaction to Widal test not very marked.
Chilsey Green, Chertsey	June 2nd (bed on 7th)	Man	Unknown	He worked out of the district from May 25th to May 27th. No local defect discovered. Patient removed to hospital on June 14th.
Drill Hall Road Chertsey	Sept. 4th	Child, aged 3 years	A "Wasting" Cesspool close to house	Diagnosis confirmed by the Widal test. Another child ill at same time with diarrhoea.
Chapel Park, Addlestone Grove Road, Chertsey	Sept. 9th Sept. 25th	Youth, aged 17 years Youth aged 15 years	Local Defect of Drain and Cesspool Unknown	He worked at Chertsey. Patient removed to hospital on Sept. 23rd. No local defect discovered. He worked daily at house in Guildford Street.
St. Ann's Road, Chertsey	Oct.	Woman	Local Defects of Privy and Drains Unknown	Patient removed to hospital on Oct. 7th
Simplemarsh Road, Addlestone	Oct. 9th (bed on 14th)	Man		No local defects. He worked daily out of the district. He ate mussels on Sept. 24th.
Chapel Park Road, Addlestone	Nov. (bed on 21st)	Woman -- Child, aged 4 years	Local Defects of Drainage	Patients were removed to the hospital on Nov. 28th.
Station Road, Addlestone	Nov. 28th	Child, aged 4 years	Local Defects of Drainage	Patient removed to hospital on Dec. 3rd.

SUTTON.

Situation of Premises	Date of Attack	Person Atta'k'd	Probable Source of Infection and Remarks
Morland Road	April 20	Girl, Aged 17	She came here ill from service in Mulgrave Road. Was removed to hospital on May 4.
Sherwood Park Road	June 2	Man	Died June 24. He went to London daily, but serious defects of the drains were discovered here.
High Street	August 11	Man	He was brought here from Hammer-smith on August 20, ill with the fever
Beulah Road	Sept. 4	Boy, Aged 14	He was removed to the hospital on September 15. His duties took him daily to several parishes in the neighbourhood.

CARSHALTON.

Wandle Mount	January	Boy, Aged 5	The drains at the back of the house were found to be leaking badly, and to be otherwise defective. He was removed to Hospital on January 26.
Hackbridge Road	August 22	Man, Aged 28	He was attacked two days after his return from the West of England, where he had been staying for a month.
Laburnum Villas	Nov. 11	Girl, Aged 15	She was removed to Hospital on January 10.
Harold Road	Dec. 10	Man, Aged 25	Patient was removed to the Joint Hospital on December 28. He worked daily in another district.



PROBLEMS OF A RURAL AND SEMIRURAL CHARACTER

	DRAINAGE for Cranleigh only pop sparse	GODALMING
	WATER Company source Greensand DRAINAGE complete	
	WATER E.Sry. Co. sc. chiefly Chalk some Greensand DRAINAGE for Horley only. pop sparse	REIGATE R.
	WATER W. Sry Co SW Sub & Wkg Cos also private wells DRAINAGE villages without systems pop. sparse	CHERTSEY R.
	WATER private wells only (see note)	FARNHAM R.
	WATER Company source Chalk DRAINAGE (see note) pail system & cesspools	LEATHERHEAD
	WATER Lambeth Company source River DRAINAGE nearly complete	ESHER
	WATER Lambeth Company source River DRAINAGE nearly complete	MOLESEY
	WATER S.W. Subn. Co. source River - private wells DRAINAGE Subsoil (see note)	EGHAM
	WATER West Surrey Co source River DRAINAGE in progress	WALTON
	WATER Company source Bagshot beds DRAINAGE nearly complete	FRIMLEY (CAMBERLEY)
	WATER Company sources Greensand DRAINAGE complete	DORKING
	WATER E.Sry. Lhd. & Sutton Cos. sources Chalk DRAINAGE systems reqd. for increasing pops.	EPSOM R.
	WATER East Surrey Co source Chalk DRAINAGE for Blechingley only	GODSTONE
	WATER Four public supplies & private wells (see note) DRAINAGE systems for Ripley & Shere only	GUILDFORD R.
	WATER Co sc. Grnsd (Leith Hill) for Westcott & Holmwood DRAINAGE no systems pop. very sparse	DORKING R.
	WATER Lmbh. Co & Corpn sources River & Chalk DRAINAGE complete	CROYDON BO
	WATER Metptn. Cos scts chiefly River partly Chalk DRAINAGE complete	LONDON COU



It is hardly necessary to say that the communication of the results of these inquiries to the Council is very highly appreciated. Indeed, having regard to occasional demands upon the County Medical Officer of Health for information in questions of urgency, relating especially to sources of public water supply, he would be particularly grateful for early returns and particulars of all Typhoid cases, as they occur, in any part of the County.

VI.—DOMESTIC WATER SUPPLIES.

In the two last Annual Reports, the County Medical Officer of Health has arranged the information he possessed for the use of the Council. The Report for 1896 was devoted to explanation of the conditions on which the spread of Typhoid depends. In that for 1897 principles of administration in relation to the occasionally alarming Typhoid epidemics spread by Water Supplies were discussed. To what is said in those Reports there is nothing at present to add. It has now to be shown what progress has been made in applying the knowledge and principles to systematic sanitary work.

In the first place, with regard to the systematic watching, examination, or control of public water supplies, in respect of "quality." The instructions of the Sanitary Committee, and the conference of responsible medical officers of health within the County, may be briefly recalled. A record of the proceedings and conclusions is contained in the Annual Report for 1897, pp. 27-45. The medical officers may congratulate themselves that by degrees a clearer conception is being gained of what their responsibilities are in this very important matter, and how their duties may be most efficiently discharged. The resolutions arrived at have been distinctly helpful in leading to a better understanding among some of the parties concerned, as will presently be seen ; but a good deal yet remains to be done in explaining the chief points that need to be insisted upon. A typical case, which occurred in the year 1898, serves to illustrate the argument of the medical officers of health. It was one in which the County Medical Officer

of Health was appealed to (as President of the Medical Officers of Health Society, 1897-8) by the Officer immediately concerned. It may be thus briefly stated :—

In a country town there was a certain well in use for purposes of drinking water supply. There were houses in the immediate neighbourhood, and in these houses cases of Typhoid had occurred in 1897. The medical officer of health, to whom the cases were reported, knew from the geological structure of the ground on which the houses stood, that there would be danger of water contamination in the event of subsoil pollution, such as might occur from any defective drain or cesspool. The local knowledge which he possessed was of itself sufficient to enable him to decide on a course of action. Indeed, the case was hardly one in which it was necessary to resort to chemical or bacteriological analysis. The water would be condemned independently for reasons thoroughly appreciated by medical officers, who, be it remembered, are charged with the duty of reporting on conditions which threaten to render domestic water supplies dangerously impure. But, as a matter of fact, analyses were made under the medical officers' directions, with the result that it showed signs of organic impurity, not to an alarming extent when taken by themselves, but furnishing additional proof of danger when taken in conjunction with the situation of the well. There being a much safer source of supply at hand, the usual proceedings were taken to substitute it for that which was regarded as dangerous. When the case came before the court of summary jurisdiction two chemists appeared for the owner and pronounced the accused water wholesome on chemical

grounds, as they were quite entitled to do. The results of their analysis closely corresponded with one put forward by the medical officer: the difference lay in his interpretation, which was influenced by knowledge not within the reach of the chemists. The magistrates before whom the case was tried did not, however, appear to see this point. They persisted in still treating the question at issue as purely within the domain of the laboratory, and accordingly referred a sample to three well-known official analysts. These chemical authorities, from the results of their analysis, went so far as to say that the water was "not liable to contamination," and "not likely to prove injurious or dangerous to health." With this quasi-judicial pronouncement the matter would have ended, but the medical officer of health was determined not to let it rest. The certificate was brought to the notice of the Incorporated Society of Medical Officers of Health, and as the best means of establishing the rights of the case at this stage it was arranged that a question be asked in Parliament of the President of the Local Government Board. It devolved upon the County Medical Officer of Health, as representing the Society for the time being, to explain the situation to those who could command attention. In so doing he derived great advantage from the fact that the points of the medical argument had already been set out, numerically and logically, in the Report published under the auspices of the Surrey County Council.

In the illustrative case now mentioned, it was ultimately acknowledged that the medical officer was right, although if the proper explanation had not been insisted on in a most determined way there is no doubt that a totally different impression would

have prevailed. The case is reverted to here not so much on account of its local importance, but because it affords an apt illustration of what may be termed "laboratory fallacies in sanitary questions." It may thus help to dispel the immense amount of confusion which has existed, and still exists, in the public mind respecting the value and meaning of water analysis. It further exemplifies the great practical advantage of the subject being taken up by an influential County Council.

Recurring to the main argument of these Annual Reports respecting Typhoid and its prevention, the fact that the disease is unfortunately never absent from any part of the country is the main factor of the problem with which sanitary authorities have to deal. Is this endemic (*i.e.*, continually present) Typhoid preventable by good sanitary administration, or not? There can only be one answer to this question. Ever since the causes of Typhoid were fully explained to the public, its continued presence, sometimes in marked excess, constitutes a serious reflection on the administration of the district in which it occurs. The cases which arise every year do not generally occur as "outbreaks," and frequently attract very little notice. In the aggregate, however, these sporadic or scattered cases amount to such a number that even the Maidstone epidemic seems small in comparison. Every case of this kind, especially where it occurs within an area from which water supplies are drawn, is a serious danger, because it so often happens that infectious matters are not properly dealt with, and are allowed to contaminate the earth. If in any district the annual prevalence of Typhoid is regarded with indifference, that district becomes a source of danger to the whole County.

Public attention may be usefully directed to a comparison of the records of the 33 districts in the accompanying Chart, of the rates of Typhoid prevalence and mortality in different parts of the County. Alongside of the facts as to Typhoid prevalence, those relating to water supply and drainage are partially given. They cannot as yet be fully stated, because none of the local reports are so exhaustive as to supply the requisite data. A good and abundant water supply may be at hand, but not utilized; a drainage system may have been constructed, but the houses may not have been connected, or the drains may be unflushed. But without waiting further it may be confidently affirmed, from previous experience, that wherever a local excess of Typhoid prevalence is noted, there also inquiry will reveal a multitude of defects in domestic water supply and drainage, frequently associated with a very lax administration of those clauses of the Public Health Acts by means of which health nuisances arising from filth within or in the vicinity of dwellings might be speedily and effectually removed.

Proceeding to the record of the executive work under this section of the Annual Report, the County Medical Officer of Health has to express his regret that as regards the detailed account of the water supply of houses within their districts, the reports of the District Medical Officers of Health are generally incomplete. Important exceptions have to be made in the case of the Croydon and Guildford Rural Districts, where work of the requisite kind is at any rate in progress. One reason for this state of things being permitted to continue was touched on in the Annual Report for 1897. It was mentioned that District Councils frequently combine two distinct offices in that

of the Surveyor. Under this arrangement the Surveyor and the Sanitary Inspector are one and the same person. In such cases almost invariably the work of the latter officer is indefinitely set aside for that of the former, which is thought of as more important. Nevertheless it is the Sanitary Inspector's part of the dual office which entitles the District Council to claim repayment of half the *total* salary from the County fund. But, at the same time, it is the work of sanitary inspection, especially which, the more able and zealous the Surveyor is, the more he finds it difficult to carry out satisfactorily. The necessity of this work, from the County point of view, is evident, especially as the Council is more and more referred to on questions of domestic water supply. It therefore becomes the duty of the County Medical Officer of Health to inform the Council that the reports referred to him show that this department of sanitary administration needs to be amended or reinforced.

As regards the inspection of water-sheds, gathering grounds or protective areas (*i.e.*, areas of ground affected or liable to be affected by pumping operations), some progress has been made upon lines which are calculated to be productive of good results. Inspections have been made by the Officers jointly concerned in the Farnham and Frimley Districts, with the result that useful and practical action has been taken by the authorities concerned. In the case of the East Surrey supply, the need for sewerage systems at Kenley and Purley was emphasized by the County Medical Officer of Health, at the Local Government Board Inquiry, in November. He was also in direct communication at the end of the year with the sanitary inspector for the District (Mr. White), respecting the safest method of disposing of the cesspool stuff of houses close to the Water Works.

The situation of the Sutton Company's source of water supply is a continual subject of anxiety, as is amply shown by the reports of the Sanitary Committee to the Council and the Local Government Board. This would in great measure be removed if the Company were forthwith to adopt the simple expedient of softening their supply on the system known as Clark's Process.

The question of the control of water companies in respect of the character of the water, which they are privileged to purvey, and the sufficiency of legislative measures for the purpose, have been much under consideration by both the Surrey County Council and the London County Council. The absence of any established right to call upon a Company to adopt a process of softening a water supply, even when the great weight of evidence proves that it would be a distinct sanitary safeguard as well as an advantage in other ways to the consumers, is an illustration of what may be required in the future. In like manner, the sufficiency of the storage and filtration works, as affecting the quality of the Southwark and Vauxhall and the Lambeth Companies' supplies, is a question that clearly concerns both the Surrey County Council and the London County Council as representative sanitary authorities, and ought to a certain extent to be subject to regulation and approval. On these very important questions the County Medical Officer of Health is continually collecting information.

The West Surrey Water Supply Works have been visited four times. On one of these occasions a number of gipsies had been allowed to encamp on the shore, just above the intake

of the Company. The attention of the Sanitary Authority concerned was immediately directed to the possibility of danger, and the encampment was forthwith removed.

Some of the Companies have favoured the County Council with copies of the analyses of certain samples, made for them by well-known chemists, of the water supplied by them. District Councils have also sent the results of analyses of samples taken independently. But the taking of samples has not as yet been conducted on a sufficiently systematic plan to allow of the analytical results being summarized. It was thought that perhaps some typical examples might be given in this Report, but after further consideration and consultation the conclusion arrived at is that it would be preferable to confine the circulation of these selected analyses to the Committee. Copies of the analyses are accordingly struck off and sent herewith to each member of the Sanitary Committee.

From a consideration of the whole subject of Water Examination, now briefly reviewed in its practical aspects, it naturally follows that along with "systematic inspection" there must be associated "independent laboratory investigation." In this way alone will it be possible to carry out such a complete examination of the sources and character of a public water supply as would give confidence to the public. It is difficult to see how this end can be attained without a suitably equipped County Laboratory under proper direction.

The following extracts from the Reports of the District Medical Officers of Health serve to indicate the kind of investigations that have been proceeding, and the sanitary improve-

ments that have been achieved in the direction of Domestic Water Supplies in the County :—

Dr. Jacob writes :—“In April the Surrey County Council drew the Council’s attention to the danger of the pollution of the water in the well at the Sutton Water Works by the soakage from the ‘wasting’ cesspools in the chalk, into which a considerable number of the houses at Sutton were still draining. The Council had all along been fully alive to the importance of getting rid of all these cesspools, and they availed themselves of the opportunity thus afforded them for serving further notices on the owners to connect the drains of these houses with the sewers. As the result of their action, the drains of sixty-nine of these houses were diverted to the sewers during the year, and sixty-seven of the cesspools were emptied and filled up with earth. The Council also decided to extend their sewers to the extreme south of the district, where a good many of these houses are situate, at a distance of over a mile from the Water Works, and, after their Surveyor had prepared the necessary plans and estimates for the work, they applied to the Local Government Board to sanction a loan for carrying it out.”

“In January, at the invitation of the Council, a conference of delegates from the Council and from the Epsom Rural, Croydon Rural, and Carshalton Urban District Councils (whose districts are supplied with water from the Sutton Water Works), was held at Sutton, to consider the question of the probability of the pollution of the water by the soakage into the chalk of the noxious matter from the graves in the Cemetery at the Banstead Lunatic Asylum. The Cemetery is about two miles from the Works, and the level of the water in the chalk at that point is

about 150 feet below the surface of the ground, but it was alleged that, owing to fissures in the chalk, the under drainage of the Cemetery might rapidly find its way down to the water-level, and that the direction of the flow of this underground water was direct to the Water Company's well—a point on which experts differ. After some discussion, the delegates decided to recommend to their respective Councils to petition the Home Secretary, the Local Government Board, and the London County Council to stop the interments, and to adopt cremation at the Cemetery, and the petitions were forwarded in due course, but so far nothing has resulted from them.”—*Sutton District Council Report*.

“In January the Council decided to join the Croydon Rural District Council in the cost of obtaining reports from Dr. Klein on the results of his bacteriological examination of the water supplied to their respective districts by the Sutton Water Company, and in March they received his first report upon the water, which was to the effect that the sample contained a comparatively small number of microbes, and that none of the microbes present were harmful; but that the water contained certain bacilli and their spores, from which he concluded that it contained, ‘in a small degree, admixture with surface microbes.’ Subsequently, the Council decided to be content with the periodical reports on the water which are issued by the Water Company, and which have proved to be satisfactory.”—*Carshalton District Council Report*.

Dr. Jacob again writes:—“During the year I made a chemical examination of 15 samples of the West Surrey Company's water, which were taken every month from one of the public drinking

fountains, and sometimes from both of them, and of one sample of the water supplied by them to a house in the district, and I found—(a) That 8 were very slightly turbid, and deposited an appreciable sediment, consisting partly of mineral matter and partly of vegetable débris, while the other 8 were bright and clear; (b) That the quantity of dissolved organic matter in the different samples, as measured by the ‘oxygen required to oxidise’ and the amount of ‘organic’ or ‘albumenoid’ ammonia, varied very much indeed, the former ranging from $\cdot 012$ to $\cdot 108$ grains per gallon, and the latter ranging from $\cdot 055$ to $\cdot 195$ parts per million.”

“Samples of the company’s water were also sent to the Jenner Institute of Preventive Medicine for bacteriological examination, and were all reported to be satisfactory. Those which were found on chemical examination to contain the largest quantity of nitrogenous organic matter did not give a less satisfactory bacterioscopic result than the others.”—*Weybridge District Council Report*.

Dr. Walcot, of Camberley, writes:—“During the past twelve months water has been laid on to 165 houses, making a total in the Frimley District of 415 connections. Additional storage for about 750,000 gallons of water has been provided at the Frimley Green Pumping Station, a second filter bed has been completed, and a third is in course of construction. About ten additional miles of mains have been laid, including the high level district, and a second engine and boiler have been fixed at the works, and are now running. The monthly chemical examinations of the water have been continued, and from time to time independent analyses have been made, both chemical and bacteriological. During the year I

made a special report on the source of the water and its surroundings, and therein stated that, as far as I was able to ascertain, every care was being taken to prevent the possibility of pollution.

“From the above remarks it will be seen that the original well-water supply of our District is gradually being replaced by water from the Company’s mains; but there are still many wells being used which are open to suspicion, and it will be our endeavour in all such instances to induce the owners to provide a good supply.”—*Frimley District Council Report*.

Dr. Lorimer, of Farnham, writes :—“In my last year’s Report I laid special stress on the great want of an efficient water supply in various parts of our District, and welcomed the Wey Valley Water scheme as one that would be ‘an inestimable boon to the District, a regular supply of good pure water being necessary for the Public Health.’ Since this Report was penned the Wey Valley Water Company have succeeded in obtaining from Parliament the powers they asked for excepting the supplying of Haslemere, a result largely due to the support given to the Bill by the Farnham District Council and the County Authorities.

“I have no hesitation in saying that had the Bill not received that support the Company would not have obtained the powers they did.

“I am pleased to be able to report that the Company are losing no time in pressing forward with their work, and already mains are laid to Wrecclesham, Badshot Lea, The Bourne, and on towards Frensham.”—*Farnham Rural District Council Report*.

It is with pleasure that the County Medical Officer of Health records in this Report such advances in the sanitation of the South-west Division of the County. On the other hand, it is with sincere regret that he has to note, immediately afterwards, the fact that the Hambledon District Council was, during the year under notice, found in opposition to the schemes for providing the Haslemere portion of their District with a good and regular water supply. Their action in this respect was certainly "anomalous" for "a Sanitary Authority" to take. In a proof furnished by the County Medical Officer of Health to the promoters of the Wey Valley Bill, before the Committee of the House of Commons, the need of a water supply for Haslemere was set out, but unfortunately the tactics of the opposition prevailed to the extent of shutting out this part of the evidence. So that it is only the Shottermill part of Haslemere (which lies outside the Hambledon area) that will have the advantage of a water supply from the Wey Valley Company. Here be it noted that the District of Hambledon, notwithstanding the sparsity of population and its great natural hygienic advantages, is by no means one of the better-class districts in respect of Typhoid prevalence. The Medical Officer of Health for the District comments on the fact that Cranleigh, Bramley and Shalford, with an aggregate population of 6,700 (less than one-third of the whole district) are alone furnished with a regular water supply.

In spite of these shortcomings great progress is being made in West Surrey as a whole. This section of the Report may appropriately conclude with a reference to the Woking Water Supply—"a most pressing and momentous question." At the close of the year 1898 it was engaging the attention of several

Sanitary Authorities, under the watchful guidance of the County Council as represented throughout by the Chairman. The whole account of the action taken in respect of this important matter will be given in due course, but this Report would be notably incomplete if it failed to record with the highest satisfaction that the future welfare of a most growing residential part of the County, in respect of such an essential condition as a good and regular water supply, has been practically secured; and that this most desirable result has been due to the consummate ability with which diverse and sometimes conflicting interests have been reconciled.

It only remains to add to this chapter that the advice and assistance of the County Medical Officer of Health has at all times been freely at the service of the District Authorities as well as that of the County at large.

VII.—SANITATION OF DWELLINGS.

Although this part of the subject cannot well be dissociated from those discussed in the foregoing sections, it is convenient to collect observations and reports bearing specially on dwellings under a distinct heading. Some of the most valuable preventive measures which District Councils have it in their power to promote is the sanitation of dwellings, especially those houses and tenements which, being let at weekly rents, so frequently tend to become unhealthy to the occupants in the absence of proper sanitary supervision by authorized persons. The list of "nuisances removed or abated," which forms part of every Annual Report forwarded to the County Council, may be considered by many to be unattractive, and is liable to be passed over. But the substantial improvement in domestic comfort and health which it represents will be evident to those who give the subject a moment's thought. The "crusade against Consumption" will be all the more effectual if the influence of sanitation in reducing the prevalence of the disease is constantly kept to the fore. Rooms that are dark, ill-ventilated, dirty, and overcrowded, are hot-beds for the spread of Consumption, a disease which is also fostered by damp, ill-drained, and foul-smelling basements of dwellings. The work that good Sanitary Authorities do every year through their Inspectors in removing the sanitary defects, so constantly found in old houses, as well as in taking cognizance of overcrowding, is of the highest and best kind. Its results will be felt in the future in a diminished prevalence of tubercular disease, unless the fashion of erecting huge piles of buildings so close together

as to shut out both air and sunshine from each other should continue to grow. Happily there has as yet been no manifestation of this backward tendency in the Administrative County, even where, owing to its central position, the building land may happen to be of very high value.

During a long and varied experience, the County Medical Officer of Health has become very intimately acquainted with all the obstacles to the sanitary improvement of "working-class houses" and especially those of the older kind, which constitute so-called "slum property." He is desirous of acknowledging fully the valuable work done by officers of the districts near the Metropolis. But with his knowledge of those districts, and with the exceptional opportunity he has had of drawing comparisons, he is inclined to think that the work accomplished in the administrative area, say within twelve miles of the Metropolitan boundary, is not quite up to the standard which is now generally adopted in London, and which is based on the recommendations of the Royal Commission on the Housing of the Working Classes, which sat in 1884.

This is the first occasion on which comparison has been possible in the rate of prevalence of Typhoid in London with that of the Boroughs and districts contiguous thereto. The Council will observe with disappointment that in spite of the advantages attaching to their situation and surroundings, they exhibit no such superiority as might have been naturally expected in respect of this most preventable disease. The subject is one which deserves the careful consideration of all authorities concerned. It is one in which the services of the County Medical Officer of Health would be available, with the consent, of course, of the County Council. It may naturally

be expected that the ancient towns of Richmond and Kingston, parts of which are very closely built, require even more than the average amount of sanitary supervision; and the same is true of the lower parts of Wimbledon and Mitcham. The condition of the last-named place has been specially under the Council's notice during the year 1898, there having been an Inquiry held on application of the District Council, in accordance with the provisions of Part III. of the Housing of the Working Classes Act.

Typhoid, though more common in dirty and overcrowded houses (especially where, as at Kingston, there is no isolation hospital), is by no means confined to such residences. The need for well-qualified Sanitary Inspectors in a district chiefly comprised of houses "let on lease"—viz., Surbiton—was insisted on in the Quarterly Reports for 1892. That the Council did well to persist in supporting the recommendations of the Medical Officer of Health is now shown by Dr. Owen Coleman's Report:—

"I am well able to testify that the sanitary work of Mr. Nesfield's department has never been more thorough and so up-to-date. Since his appointment, now some $2\frac{1}{2}$ years, no less than 295 houses have been re-drained, for the most part entirely, and a considerable amount of drainage work is at present in progress. The deduction from all this is that by degrees houses of all descriptions in Surbiton will of necessity become well drained and increasingly healthy, and its character as a residential neighbourhood be immensely added to. Owners have no option but to have their houses re-drained in a thoroughly serviceable manner when defects are discovered. This process of discovery

is going on apace, and must and will go on until houses are well drained. A house of any pretensions is now scarcely ever let on lease without the incoming tenant employing experts to test and report on the sanitary arrangements, with the result, as I have stated above, that drainage that is wrong must be put right. The working of the Notification Act also tends in the same direction, for following on infectious illness or other illness, either as the consequence of an inspection by the Sanitary Inspector, or acting on the advice of the Medical Practitioner, tests are applied, defects discovered, and remedial measures insisted on, and, if necessary, enforced by your Council. The experience gained by the Sanitary Inspector during his term of office has been most valuable, and the Council and the whole district can congratulate themselves on the way their interests in these respects are looked after.”—*Surbiton District Council*.

The Medical Officer of Health for New Malden (Dr. Rashell Davison) makes some very noticeable observations on the insufficiency of the powers of the Public Health Act in respect of what may be called acutely dangerous nuisances. He reports as follows :—

“In October we were the victims of another serious nuisance at the Gravel Pits, Dickerage Lane. A neighbouring authority deposited foul refuse and garbage in a large gravel pit full of pure spring water, used by the residents for fishing and bathing in the summer and skating in the winter.

“The Council took every means in their power to compel this neighbouring authority to cease tipping refuse and abate the nuisance. Although a notice was served on them to cease

and abate the nuisance in seven days, owing to delay, consequent on legal proceedings, they continued their work for nearly a fortnight.

“The Bench of Magistrates, in giving their decision, said ‘the poor people in the vicinity of this gravel pit had been badly treated by the authority in question depositing their refuse in this particular spot.’

“Sore throats, diarrhoea, and other ailments possibly attributed to this nuisance have been prevalent in nearly every house; some have had to cease work, all have been put to more or less expense. Surely this case points out the necessity of every Council having some swift and certain method of dealing with a nuisance likely to be injurious to the surrounding population. Had there been anyone who had authority—say the Chief Medical Officer of the Local Government Board or our own County Medical Officer—to give a certificate that, in his opinion, there was a nuisance, and that it must cease at once, until legal proceedings or arbitration had determined the course to be taken, all these poor people would have been saved illness and expense, and the District the cost of legal proceedings.”

The following extracts from the reports of Medical Officers of Health of the parts of Surrey indicate that much valuable work is being accomplished, even under the existing conditions of inadequate sanitary inspection :—

Dr. S. G. Sloman, of Farnham, writes :—“The Surveyor has been making a systematic inspection of the town and tabulating the results, so that a most valuable amount of information is being accumulated and the defective premises are being brought to the notice of the Council month by month.

As a result of this action I am glad to be able to report that 77 houses have been provided with efficient flushing to their closets (which had not had it before), besides 14 other houses which have been provided with an amended supply, most from the Water Company's mains."

Dr. Hall, the Medical Officer of Health for the Hambledon Rural District, writes :—"Shalford, with a population of 2200, had 5 cases of Enteric Fever. Here there were found two wells, which, on analysis, were pronounced unfit for drinking purposes. Most of the cases occurred at Mitchell's Row, and all drank of the polluted wells. The privies at the back of these houses were found in a most disgusting condition, and far too close to the premises. These were advised to be altered into earth closets, and water supplied to these houses from the main. This was done, and no more cases occurred."

Dr. Walcot, of Camberley, writes :—"It is worth mentioning that Dr. Lorimer, Medical Officer of Health to the Farnham Rural Sanitary Authority, in his Report for 1894, said (referring to the Frimley District): 'My firm opinion is that until these two conditions are provided—namely, good surface drainage and a good water supply—this portion of the district will remain in an insanitary condition, and that outbreaks will occur from time to time.' There are still a large number of water-closets having no water supply, and I would impress upon the owners of such property the necessity there is for doing away with this easily-remedied defect."

Dr. Oldman, the Medical Officer of Health for Caterham, writes :—"A return made by the Sanitary Inspector in the spring showed that out of a total of 345 working-class houses at Upper

Caterham, 200 had water closets with no flushing apparatus. Caterham Valley and Whyteleafe would show a similar proportion."

"Apart from the filthy condition such closets are usually in, there is a grave danger, especially in dry weather, of the drains being insufficiently flushed, and as the tenants use on their gardens the slops and waste water that at other times would be thrown down the closet."

The most serious nuisances in the dwellings of the working classes arise from overcrowding.

It is sometimes said that there is no need for hospital accommodation in Rural Districts because the population is so sparse. If, by this remark, it is intended to convey the idea that there is a comparative absence of overcrowding, a false and very mischievous impression may result. The fact is, there is a great deal of overcrowding in country cottages. Now and then a case is accidentally revealed, but for every case that thus becomes apparent there are probably a hundred of which no cognisance is at present taken. Be it remembered that the overcrowding of cottages, besides ministering to the spread of infection, is a most fruitful cause of other intense evils. One of the most ghastly horrors sometimes associated with overcrowding may be banished by the action of a Sanitary Authority in establishing a proper mortuary in which examinations, which are sometimes necessary for medical and legal purposes, may be properly and decently conducted. It is only right to mention here that the Coroner, G. F. Roumieu, Esq., J.P., who takes an active interest in questions relating to public health, has never failed to use his powerful influence in securing the establishment of a proper mortuary for every district in the County.

VIII.—COWHOUSE AND DAIRY SANITATION.

The attention that is now being directed to the Sanitation of Cowhouses, and to the conditions affecting milk which is intended for human consumption, is a sure sign that before very long great improvements will somehow or another be effected in this department of sanitary work. The County Council has already taken the first essential step towards improvement—viz., that of diffusing information throughout the County. There are in Surrey many excellent models of what cowsheds should be in respect of light, ventilation, air space, cleanliness and drainage. On the other hand, there are others that stand much in need of improvement. It may be expected that next year the reports of Medical Officers of Health will contain more detailed accounts of the condition of the cowsheds in their districts than hitherto.

In the meanwhile a few references to this very important subject in the reports for 1898 may be quoted here.

Dr. Rowland, the Medical Officer of Health for Richmond, writes:—

“Tuberculosis is now asserted to be a preventable disease. The view taken—to keep within the limits of present scientific knowledge—is that the active cause of Tuberculosis in children is largely the use of the milk, as food, from tuberculous Cows, the ill effects of which are to be prevented by sterilising the milk by heat—somewhat under the boiling point, about 160° Fahr., will do this. Of course the use of milk from cows so affected is to be avoided. The consumption of milk at the adult period of life is very slight.”

Dr. Oldman, the Medical Officer of Health for Godstone Rural District, writes :—

“The cowsheds in the district are generally of fair construction, but the way in which the cows are kept frequently leaves much to be desired. Cows are rarely groomed in winter, and, their hind-quarters becoming caked with filth, it is almost impossible to avoid contaminating the milk from what is rubbed off the hide in the process of milking, even assuming the udders to be clean, which is not always the case.

“Some of the sheds are overcrowded. Each cow should be allotted a space of not less than 800 cubic feet. There are sheds which barely provide for half that amount.

“In cold weather it is the custom to completely stop all ventilation, and as the ventilator is generally the means of the admission of light also, the cows are kept in semi-darkness during such periods.

“Dairies are frequently used as pantries and store rooms, and where this is the case, it is difficult to maintain that scrupulous cleanliness so essential in the storage of milk.”

Dr. Senior, Medical Officer of Health for Esher and the Dittons, writes :—

“I wish to draw your attention to the necessity for ensuring that cows are kept under sanitary conditions, that the cowsheds are well lighted and ventilated, and that they are efficiently cleansed. In this district all cowsheds are registered and are under inspection, and in most instances are well constructed and properly kept ; but there are a few, I fear, that cannot be considered as perfect as they should be.”

To the above the County Medical Officer of Health desires to add an observation which is in agreement with that contained in the Report of Dr. Beale Collins, of Kingston-on-Thames. The milk supply of that town is largely from Hampshire and Dorsetshire. That of Richmond is partly from Buckinghamshire. Other populous parts of Surrey depend for their supply upon several counties in the South of England. It cannot be denied that in some of these sanitary administration suffers from neglect. The Council may be reminded of a Report of the Sanitary Committee which appeared in the Quarterly Volume, 8th of May, 1894, pp. 105-8.

From these observations it must follow that in order to secure effectual improvement and supervision of dairy farms, a sufficiently comprehensive system of administration is essential. In the meanwhile a great deal may be done by careful investigation and reports, which in due course have to be presented to the respective County Councils.

GENERAL.

There are always a few subjects referred to in different reports which may be conveniently dealt with under a general heading.

1.—*Official Inspection of Public Institutions.*

The Medical Officer of Health for the Frimley district, Dr. Walcot, writes :—

“ The health of the inmates of the Royal Albert Orphan Asylum has been very good. No cases of infectious disease have occurred; but the average number of children in each dormitory has practically been the same as last year, *and the cubic space and superficial area per head remains under the proper standard.* The cleanliness of this institution is all that can be desired, and one great improvement has been the introduction of a water supply from the Frimley and Farnborough Water Company’s mains.”

2.—*Abatement of Nuisance by co-operation of Sanitary Authorities and assistance of the County Council.*

The Reports for 1898 afford a conspicuous example of nuisance arising from sewage pollution, such as that which “ can be compared to that of the Brent in Middlesex,” in which different Sanitary Authorities were concerned. The pollution of the Beverley Brook near Worcester Park, which is now referred to, was the subject of many complaints, differently reported on according to the view point of the Sanitary Authority. In this case the County Medical Officer of Health used his best endeavours to prevent delay, such as often occurs where the interests of neighbouring authorities are in conflict. The condition of things threatened at one time to become very

serious to the Maldens district. This is shown by reports of Dr. Davison (Malden) and Dr. Williamson (Cheam). The former now reports :—

“That the drainage scheme in Old Malden has been finished, and the few houses at Worcester Park connected. No house in this district now drains into the ditch ; therefore there can be no contention as to the pollution, the authority at Cheam being alone responsible.”

Other improvements effected contemporaneously were referred to in the Sewage Disposal Works Report, p. 109.

Further action may have to be reported subsequently ; but it is at any rate satisfactory to record the above-mentioned improvements, which this Council may claim to have materially assisted in bringing about.

3.—*Scavenging Systems adopted.*

In last year's Report the immediate necessity for a scheme of Scavenging, to be applied to Hale, Heath End and Badshot Lea, was urged.

It is unnecessary to repeat here the arguments used by me in that Report.

The Council, recognising the necessity of something being done, have inaugurated a scheme of Scavenging for these Districts. This will be a great boon and a most important sanitary step in these growing neighbourhoods, neighbourhoods which are becoming in their character more Urban than Rural, and possessing in most instances quite an insufficient area of ground for the disposal of sewage, dry or otherwise.

4.—*Mortuary Provision.*

The Medical Officer of Health for Godalming, Dr. Parsons, writes :—" The mortuary is finished and ready for use. I shall take an early opportunity of inspecting and reporting upon it in detail."

5.—*Burial Grounds and Cremation.*

Surgeon-Major Wellington Lake, Medical Officer and Deputy Coroner for the Districts including Woking, writes :—

"The question of providing more ground for the burial of the dead is one which must engage the attention of the Council at the earliest possible period.

"With a view to meeting the pressing emergency in the Village Ward, the Right Hon. the Earl of Onslow has generously presented the Ecclesiastical Authority with one and a-half acres of land in immediate proximity to the present churchyard.

"At St. John's, the only other burial ground in the parish, except the Necropolis at Brookwood, the present space will shortly be filled up, and the ground no longer available for the purpose for which it has been so long used."

Dr. Beale Collins, of Kingston, writes :—" In the neighbourhood there is plenty of openland away from houses and of suitable soil, within three or four miles of the Borough, and at a less distance from some of the places for which the Kingston Cemetery serves. The establishment of a Crematorium would certainly be a boon from the sanitarian's point of view, and if the charges were low it would be largely used when the people became accustomed to the idea."

REPORT
BY THE
COUNTY MEDICAL OFFICER OF HEALTH,
ON
METHODS OF SEWAGE DISPOSAL IN OPERATION
IN THE COUNTY.*

IN accordance with instructions received from the Sanitary Committee, that he should summarize his information on the working of the various systems of sewage disposal in operation in the County, the County Medical Officer of Health has collected his notes of the last four years. He has furthermore made recent visits to all the Works in order to refresh his memory on certain points about which he has made note at various times; also, too, that he might be able to present the latest account of works in which the systems have been more or less changed. He has been in communication with Engineers, Surveyors and Managers on many questions of detail in construction and management. He desires to thank them for the assistance they have at all times so willingly and efficiently rendered him.

The County Medical Officer of Health desires also to say a few words, by way of preface to this Report, of his qualification to write as an expert critic on this very important subject. It is one in regard to which his official responsibility extends back

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for more than twenty-five years, and he was necessarily familiar with all points raised in the discussion of the Stoke Farm scheme, which was carried out more than twenty years ago by the very able Chief Engineer of Nottingham. During the last seven years he has had specially varied experience such as could hardly be obtained elsewhere than in the residential County of Surrey. By attending the numerous inquiries, he has been in confidential communication with some of the best-known experts, and has listened with profound attention to their arguments and opinions. His numerous inspections in connection with tentative and proposed schemes, and his continual visits to works now in operation, have afforded him every opportunity of verifying information by his own unbiassed observation. Above all, he has had the advantage of discussing various points with the Chairmen of the Sanitary Committee, viz., the late Admiral Egerton, the late Mr. Henry Yool, and Mr. William Welch. The great interest Mr. Yool took in the intricate subject of sewage disposal is of course well known. The Weybridge system is itself a monument to the memory of his eminently useful life.

During the last four years Mr. Welch, the present Chairman, has been so good as to accompany the County Medical Officer of Health on visits of special import in the County and borders thereof as well as to Andover, Exeter, and Southampton.

HEALTH ASPECTS OF THE DRAINAGE QUESTION.

This is not the occasion for discussing exhaustively the health aspects of Drainage and Sewerage systems; but it may be well to remind the Committee of the most essential considerations, which have compelled the attention of public authorities to this important subject.

In Surrey, the population outside suburban London may be said to be distributed for the most part in small Boroughs or Urban Districts, and more sparsely in its picturesque villages and scattered residences.

In the Annual Report for 1896 on Water Supplies in relation to the Public Health, the County Medical Officer of Health observed: "Except in the case where nuisance to the locality may be said to be caused by the discharges of factory or trades refuse into a stream, the prevention of river pollution is in this part of the country mainly necessitated by considerations of water supply in relation to the Public Health." The prevention of river pollution has been made the starting point of many of the drainage schemes, which have entailed a large but necessary expense. To the millions of persons dependent on the river sources for their domestic water supply, this expenditure will, it is believed, mean increased sanitary advantages. It is further hoped that some day the Thames will have its gravelly bed restored, and may even become again a possible breeding ground for a Salmon river. Already in one of its tributaries the conditions have improved so materially that a gentleman in the neighbourhood of Godalming is raising a very fine stock of Trout. In aid of this good work, the cleansing of the beds of streams, and removal of obstructions to the flow of streams, is very necessary. In some parts of the County the district authorities have undertaken this work with great benefit to the localities immediately concerned.

Apart from the above considerations, we have to think of the immediate benefits to a locality from the adoption of a drainage system. First, we have to think of the possibility of the

Thames tributaries being utilized for purposes of public water supply. Ten years ago the idea would have been called Utopian. But it is otherwise now, when works of sewerage and sewage disposal have so much improved the character of the river water. By the light of Bacteriology we know that processes of self-purification take place. Sedimentation and filtration are seen to be active and not passive agencies tending to improvement by natural methods. The water of the occasionally swollen streams may in future be brought into use. The advantage of abstracting and storing it at flood times is coming to be recognised. There is much to be done yet in the way of perfecting sewage purification systems, but the suggestion that water, which otherwise runs to waste and helps to create destructive floods should be stored for domestic purposes, may now be said to be well within the sphere of practical politics.

The chief direction in which the public health is immediately influenced by drainage systems is, in the case of towns such as Godalming and Guildford, by the quick removal of filth from the vicinity of closely-built dwellings, and by making the ground on which they stand cleaner and drier. The good effects of drainage in such cases cannot be over-estimated, for not only does it tend to reduce Typhoid prevalence, but, what is even more important from the health point of view, it diminishes the prevalence of Consumption. It is not known exactly how this reduction of Phthisis is brought about, but the discovery of the fact that proper sewerage and drainage systems produce this effect has long been recognised as one of the most important ever made in preventive medicine. (Corfield and Parkes, in their volume entitled, "Treatment and

Utilization of Sewage,' dwell on the need for drains supplementary to sewers in order to lower the subsoil water of towns).

In the open country, the circumstances are of course very different. Where the villages are small and the residences are scattered, it is impossible to speak in the same way of the advantages of sewerage systems. Still, sanitary authorities may be driven to adopt them by their inability to prevent river pollution by other means, and so, to benefit the public health in a wide sense, large and comprehensive schemes have to be undertaken.

The sewage disposal question has therefore to be considered from the point of view of villages as well as of town populations. But in the interests of health and economy alike, rural hygiene or sanitation should be thought of quite independently of the preconceived notions on the subject which result from the massing of the population in towns. (Poore's "Rural Hygiene" and "The Dwelling House" is full of information and valuable suggestions on this subject).

WHAT IS SEWAGE?

There are many large sewered towns in which the water closet system can hardly be said to be in vogue at all, one of the tub or pail systems having been adopted; or, far worse, the abominable privy-midden system having been retained. In such districts the general impression is that the sewage differs materially from that of London, or places where the adoption of water closets is the rule. But the experienced members of the Committee well know that such is not the case. Indeed, if specimens of the two liquids be submitted to analysis, there is very little difference in their chemical composition, and consequently in their power to create nuisance.

The term "slop water," is calculated to convey the idea that it is not so very nasty. But of what is it composed? Here is a description from a very practical handbook on sewage purification recently published, which would apply to the so-called "slop water" of any village or small town: "It contains the liquid excretions of the inhabitants, the foul waters from the kitchens, containing vegetable and animal matters, bits of fat and other refuse, the suds from the washing of dirty linen, cooking utensils, and the people themselves, holding in solution and suspension soap, fatty acids, and the exudations from the human skin. Such soapy slops, as everyone is aware, if allowed to stand for twenty-four hours, become most foul and offensive. Then there is the dirty water from the washing of floors, the swilling of yards, the solid and liquid excretions of animals in the streets, the drainage from stables and pig-sties, the blood and other animal matters from slaughter houses, silt from road sweeping, &c."—(Barwise, "Sewage Purification"). No wonder, then, that the process of dealing with the excreta by the dry earth or pail systems alone does not very materially help in solving the problem. This fact is gradually being brought home to residents in Surrey by the prosecutions of the Thames Conservancy Board.

DIFFERENT KINDS OF SEWAGE.

There is another fact, the full meaning of which is certainly not grasped by those who, as representing the ratepayers, have to consider the provision, management, and amendment of sewage disposal systems. It is that sewage is not by any means a liquid of uniform character. It varies in different towns, and in the same town or place in different parts of the day. It may be strong or weak; it may contain organic

ammonia in proportions of 20 to 25 parts per million, or it may be as low as one-tenth part of that quantity. It may be acid, neutral, or alkaline (either slightly or in marked degree). It may be fresh, comparatively inoffensive, and easy to treat; or it may be putrid, and extremely difficult to deal with. Now most of these varieties of sewage may be met with in our County

Examples of the variations to which sewage is liable will occur to the Committee in connection with the reports about the Godalming outfall works and those for Esher. The County Medical Officer of Health, in his visits to sewage disposal works, has had many opportunities of observing for himself, and learning from able and experienced managers, how these differences are to be accounted for. Samples of sewage could be exhibited which, when viewed in a two-foot glass cylinder, vary in a remarkable degree. One may appear as a black, foul, foetid liquid, and another like only slightly clouded water.

Inasmuch as the quality of the effluent produced by any given process depends largely on the kind of sewage which has to be purified, the fact of variation in the character of sewage obviously has a very direct bearing on the observations made from time to time on the efficiency of particular processes. Whereas at some works in the County different processes are available for sewage treatment, at the same time it is easy to select kinds of sewage for different treatment. Sanitary authorities should be on their guard, lest in some of the trial methods now under observation misleading inferences might be drawn by failure to recognize the very essential fact to which attention is here drawn.

Santo Crimp, in his well-known book on "Sewage Disposal Works," gives diagrams showing the hourly fluctuation in

the character of sewage. It may not be necessary to enter fully into details relating to varieties in sewage, except so far as they concern authorities in the County; but it is very essential that attention should be directed to certain points of practical importance. In the first place, "drainage separation" must be mentioned. The importance of this may be gathered from the fact that a Bill was prepared, and brought into Parliament last year, "to enable Local Authorities to deal separately with the sewage and the drainage (*i.e.*, rain and subsoil water) of their districts." When schemes are propounded at the Loan Inquiries of the Local Government Board, it is sometimes said (as at Oxted for example), "We intend to make ours a strictly separate system, and keep all the rain water out of the sewers." But the experienced know that this is not feasible in the case of villages or towns where a large proportion of the houses have drains planned to receive sewage, with roof and back yard water alike. It is of great moment that new houses should be so constructed that by far the greater part of the rainfall should be kept out of the sewers, and made to flow to the water courses by different culverts or channels. But unfortunately regulations in this regard can not well be made retrospective. It is important, therefore, that in undertaking a scheme, Authorities should have all the details worked out so that they may know approximately what volume of sewage may be expected at the Works under given conditions.

The effect, of course, of rainfall is to dilute or weaken the sewage, and it may alter the efficiency of a system in other ways, as by interference with filter beds and biological processes. But in some cases there is even greater trouble arising from the passage of subsoil water into sewers, thereby leading to

enormous dilution of the sewage, which is sometimes so weak that it looks very much like only slightly soiled or clouded water. If this "sewage" has to be lifted from the outfall receiving tank, it is plain that the volume to be pumped must very seriously affect the working expenses of the system. In the progress of works, the extreme difficulty of dealing with subsoil water in some of the strata found in the County can not fail to be noticed. The care and attention bestowed on this matter by some engineers is of immense value to the ratepayers. It has already been remarked that in towns, good subsoil drainage is very necessary, but this should be by a separate system. In country districts, with scattered population, subsoil drainage may be necessary in places, but the subsoil water should be made to flow to a watercourse. On no account should sewers be allowed to become land drains, or allow of the escape of sewage into the subsoil.

SEWAGE DISPOSAL SYSTEMS.

In the Appendix to this Report, the various kinds of systems for the disposal of sewage which are in operation in the County are to some extent classified. It may not be desirable to generalize with regard to systems, and the circumstances to which they would seem most adaptable. This would clearly be trespassing on the province of the responsible engineer. But the County Medical Officer of Health may usefully submit opinions which he has formed on certain broad questions which arise in connection with all schemes or systems.

The question of "volume of sewage" to be dealt with, and the conditions that may control it, has been referred to. It is plain that it must affect the system to be adopted. At Local Inquiries, the County Medical Officer of Health has several

times directed attention to this. If 30 gallons per head per diem be taken as the amount of water required for all domestic purposes (this is a moderate estimate in the residential districts of Surrey), we know that the sewage proper of a place of 8000 will be approximately a quarter million gallons. This is what the dry weather flow actually amounts to in one sewered district where nearly all the houses have been connected. The wet weather flow ought not to much exceed this quantity. But there are cases where the extraneous subsoil water raises the volume of sewage to four or five times this amount. It is plain, therefore, that the need for exclusion of subsoil water from sewers is a point which should be present in the minds of the promoters of any scheme, be it what it will.

In giving evidence at Inquiries, the County Medical Officer of Health has reminded the meeting that Works of Sewerage and Sewage Disposal are required for three purposes :

1. The removal of sewage to the Works in a sanitary way.
2. The dealing with the sewage at the Works without nuisance.
3. The production of a satisfactory effluent.

Generally speaking, the advancement of each of these objects—for instance, the avoidance of stagnation of sewage by continuance of pumping—assists the others. By removal of a cause of nuisance it makes purification less difficult; the skilful use of the sewage by an expert farmer not only reduces nuisances on the spot, but it ensures a much better effluent; again, by making special provision for breweries and paper works, trouble of different kinds is averted. But although, generally speaking, by aiming at one result others are incidentally attained,

it is, on the other hand, quite possible in some cases for Works to be conducted with a minimum of nuisance, and at the same time the effluent may be no better than clarified sewage. There have also been instances in the County where the existence of considerable nuisance from bad sludge arrangements has not been accompanied by the production of a bad effluent. Whatever the system adopted may be, no scheme can be called successful which does not attain all the objects mentioned.

With these objects always in view, it may further be said that, according to circumstances, sewage farms, precipitation works of various kinds, intermittent downward filtration, biological tank treatment or biological contact treatment (both with land as being still in the experimental stage), may any one of them be made to succeed, provided these two essential requisites have been secured. The first of these is that the system, whatever it is, be *good of its kind*; the second is that the up-keep should be sufficiently allowed for, and the *best available management* be provided.

Sewage farms have not been praised so much of late. This is not because they cannot be made very successful from the three points of view already named, but because the sanitary considerations have been allowed to become subservient to questions of agriculture or farm produce. Then, again, a sewage farm like that of the Croydon Corporation at Beddington, which was among the first and "good of its kind" thirty or forty years ago, is not necessarily so now. There are better and cleaner ways of disposing of sewage than that which the town of Croydon devised so many years ago. Undoubtedly at the present day the sewage disposal area at Beddington (situate in the Adminis-

trative County of Surrey) is a source of nuisance to the locality, and the time has arrived when the Corporation of Croydon may reasonably be called upon to adopt an improved system.

SITUATION OF SEWAGE DISPOSAL WORKS.

The idea generally prevails that Sewage Works are necessarily very offensive, and therefore it is thought better to locate them far away from view. This is not at all the right thing. The more the Works are under view, the better the guarantee of their proper management. Take, for instance, the Sewage Works at Weybridge, that are directly under the view of hundreds of passengers every day, on the main line L. & S.W.R. There has never been a complaint against these outfall works since they have been established. On the other hand, places out of sight are apt to become very neglected; more than one instance of this has been under the notice of the County Medical Officer of Health lately. This subject will be referred to again presently, under the head of Management of Works. It is bad policy to hide away sewage works. It is also bad policy to concentrate on one spot different kinds of business which may or may not give rise to nuisance, according to the way in which they are conducted. There are notably some places for sewage disposal in the County, and on its borders, situate very near residences, where the proximity of gasworks, bone works, rubbish shoots, &c., make it difficult to say positively what the cause of a complaint really is. In this way discredit may undeservedly attach to sewage works.

But the question of greatest importance in Surrey is perhaps the situation of works in relation to streams. Let us consider the subject for a moment from the river pollution point of view in the case of villages (a) *without*

a sewerage system and (b) *with* a sewerage system. The pollution which takes place in the former case consists of those matters which pass down the ordinary road drain, together with the overflows of cesspools which communicate with the drain. In dry weather the contents of the drain are not large in volume. They are made up of tricklings rather than discharges. The communications with the stream are diffused, and the quantity of actual polluting matter at any one point is seldom large enough to discolour a stream for any distance. Often all traces have disappeared in a mile or so, the stream having purified itself in its flow. If, on the other hand, a sewerage system serving the population of the village and its neighbourhood, have its outfall provided in a situation which is unfortunately on the brink of a stream, the risk of pollution in case of accident, or the system proving inefficient, may be greater than before. In the illustrative case now thought of the volume of polluting liquid, without the drainage, has been closely observed in its effect on the stream, and it is very slight. With a sewerage system, if a certain scheme be allowed, the volume of dirty water, instead of representing indirect overflows and tricklings, would comprise the direct discharge of all the liquid refuse of the dwellings with solids in suspension, and would not be less than 100,000 gallons daily, all of which volume would be concentrated at one point. In order to ensure protection for the stream and to safeguard it against increased pollution, not only does such a scheme need to be most perfectly designed, but its management needs to be better than any that has yet been provided.

The County Medical Officer of Health is aware that in referring to this kind of case he incidentally raises the great

question of pumping *v.* gravitation schemes. On this subject he is acquainted with the views of experienced gentlemen, and he has listened with profound attention to the evidence of the best-known experts in England, some of whom at times appear to be against pumping schemes. With every respect due to their practical knowledge, and with every consideration for difficulties inseparable from pumping schemes (such as increased initial outlay, maintenance of duplicate machinery and sometimes temporary stagnation of night sewage), he desires to take this opportunity of expressing his deliberate opinion in favour of lifting the sewage away from the streams as a matter of general policy.

Closely bound up with this question is the character of the soil as a factor in the selection of sewage sites. On this point the volume of notes made by the County Medical Officer of Health would allow ample material for discussion. Generalization is not possible. The factors which go to make a good or a bad site are so complex that a decision can only be arrived at in each case as the circumstances are submitted to the judgment of the expert. But there is just one point which is important to all authorities in Surrey, where so large a proportion of the areas thought of for this particular purpose consist of Clay, and Bagshot beds of a clayey nature. This is the question of underdraining. Santo Crimp, in his well-known Work, has shown by diagrams what happens with soils that "crack." Troubles of which so much has been heard lately have had their source in the system of underdraining where the soil is liable to crack, and the sewage matter may in consequence "short circuit" to the drain, appearing as "effluent" in a crude untreated condition. In such cases, where

the land is depended on wholly or partially for the purification purposes, the "bacteria" or "contact" bed system is likely to be of a great help.

MANAGEMENT OF WORKS.

From what has already been said, it is plain that the success of every scheme is dependent on two main factors—viz.,
 (1) The method or scheme which should be "good of its kind."
 (2) The management and supervision.

There are, unfortunately, some works in Surrey so unfavourably situated or so indifferently planned that the most perfect management may fail to bring them into line with successful schemes. But it is really wonderful what good management will do. If the works be designed so as to avoid stagnation and consequent decomposition of sewage as much as possible, and to facilitate cleanliness in every detail, they will obviously be found more easy to manage in a creditable way. But apart from all mechanical contrivances, the immense value of intelligent, experienced, and, above all, honest and conscientious management of sewage works, is a point which influential governing authorities would do well to insist on. An excellent example of what can be achieved by management is afforded by the Camp Farm on the borders of the County. The change that has lately been effected under the War Department is worthy of high praise. Generally speaking, the County Medical Officer of Health can not be much in favour of the sewage farm, properly so called, as a system in comparison with others, because there is a tendency with that method to subordinate the sanitary to the agricultural considerations. But he is bound to say that the improvement effected under the new management

almost amounts to a transformation. This case illustrates in a remarkable manner also the advantages of having a sewage site well under public observation. It adjoins and is overlooked by the Connaught Hospital. There could be no better guarantee that the management will not be allowed to deteriorate, and there is good reason to expect that in another year, when further improvements are effected, the effluent from this farm will also be of a fairly high standard. This should be fixed at 1 part of organic ammonia per 2,000,000.

To reiterate. Among experts there will always of course be champions of particular systems or methods of sewage disposal, but the broad principles that the County Medical Officer of Health desires to emphasise are these: (1) It is not so much the method, as the adaptability of the method to all the circumstances of each particular case, and above all, the way in which it is designed and executed, that should be held in view. In short, it should be *good of its kind*. (2) The successful operation of works of all kinds is largely dependent on good management and supervision. (3) To secure thoroughly efficient management, the best policy is to have sewage works well under the public observation, as when they are placed by the side of railways, or within view of main roads, thoroughfares, and public institutions such as hospitals.

EFFLUENT STANDARDS.

To revert to what has been said about varieties of sewage. The Committee recognize already in the many discussions that have taken place of new methods of sewage treatment, that success can only be judged of by a full knowledge (not easy to attain) of exactly what kind of sewage the method under observation is required to treat, and how it answers its purpose under

varying conditions. In discussing effluents, we ought therefore to be generally informed respecting the quality of the sewage from which it is produced. Sewage may be so diluted by rain or subsoil water in its passage to the works, as to be comparatively easy of treatment, or after treatment it may be diluted, and a fictitious effluent may result in consequence. Chemically considered, the amount of chlorine (one of the elements of common salt) remains fairly constant before and after treatment. Its estimation enables the observer to detect any want of correspondence between sewage and effluent. As an indicator of the extent to which purification is effected, the estimation of the organic (albumenoid) ammonia is that with which the Committee is best acquainted through the reported proceedings of the Thames Conservancy Board. The results are generally stated in parts per million, in order to dispense with decimals, and to express the proportions in integral numbers. They sometimes need to be checked by other estimations—viz., the amount of oxygen absorbed in twenty minutes or four hours, and the proportion of oxidised nitrogen as exhibited by the nitrates formed.

But for the purpose of this Report and for the convenience of the Committee it is better to speak of the organic ammonia alone as the indicator of a satisfactory effluent. Some authorities consider that an effluent is satisfactory if this has been reduced by the purification process to 1 or 2 parts per million. But the Thames Conservancy Board wisely recognizes that the destination of the effluent makes all the difference in what constitutes legitimate or reasonable demands in this respect. Certainly a high standard of effluent should be required in such cases as that of Weybridge, and places near the intakes of Water

Companies. It also should be fixed high in those cases where the large population served by the sewage disposal works, and the consequently large volume of effluent, together with the smallness of the stream into which it delivers, increases the probability of nuisance arising from the polluted water, which can only purify itself naturally under favourable circumstances. For these purposes the higher standard may reasonably be fixed at half the above-mentioned figures—that is to say, at 1 or 2 parts per *two* million. In the opinion of the County Medical Officer of Health such a standard might well be required at the present time, not only for places immediately above the intakes, but for such places as Aldershot and the Camp Farm and Farnborough, which deliver immediately into the narrow Blackwater, and for Beddington, where large volumes of effluent are delivered into the Wandle.

The powers of the Thames Conservancy Board to get authorities fined for delivering bad effluent, or for the discharges from what are termed “storm overflows,” are invaluable; they are absolutely essential to progress. But the sampling by their staff is for the purpose of detection and prosecution, not for information and guidance. This might be furnished by authorities responsible for the establishment of the works. Periodically, in some cases very frequently, samples require to be taken in order to make sure there are no faults of management, and to find out weak points in the system and its working. This sampling need not entail elaborate and expensive analyses unless this is specially required. The simple observation of specimens of effluent, after keeping, by an experienced person, will suffice in the vast majority of cases to determine whether there is reason for dissatisfaction or not. A reliable observer acting impartially,

and sometimes independently of the management, be would capable of exercising supervision on behalf of the authority responsible for the maintenance and up-keep of the works. Such supervision would undoubtedly be of sterling value in a great many instances in the County.

LOAN INQUIRIES.

In concluding this statement or report, the County Medical Officer of Health desires to direct attention to the vitally important matter which many District Councils and Local Authorities have yet to determine — viz., the choice of “a scheme” for sewage disposal. Although it may not come strictly within the scope of this Report to discuss a subject which in some degree affects the principles of Local Government, it may yet be opportune to invite reflection thereon. There seems all the more reason for doing this, because the vast majority of people who have no particular interest in the subject are generally under the impression that the Local Government Board’s sanction to a scheme implies a guarantee of its being the best for the locality or district. Every one who has had much practical experience knows full well that the Local Government Board inquiries are conducted with extreme care and conspicuous fairness, but they are, and under the circumstances must be, limited to the scheme or schemes actually before the Board. For reasons that will occur to the Committee, it would be impracticable for the Board to undertake the wider inquiry for the purpose of ascertaining what, on the whole, is the best scheme for the district. In this latter case, the standpoint from which the inquiry would be made must essentially differ from that which is allowed by the present order of things. As

it is, there is practically only one course to follow, and that is to sanction the scheme, if it meets the requirements of the Department. But when, after lengthy discussion of a scheme, with perhaps one or more alternative schemes (all of them "poor at the best"), sanction ultimately has to be given to one, not because of its merits, but because under the conditions of the limited inquiry it *seems* to be the "only possible," then there is surely good reason to be dissatisfied with the present arrangements. Enough has been said in this Report to make it obvious that a well conceived, carefully thought out scheme is the foundation of success, which is also dependent, of course, upon good up-keep and management. Altering sewerage and sewage disposal works, conceived on a plan intended to be economical, but proving inefficient, is a costly process in the end.

What is the best way of attaining the object which all County Authorities who are anxious to secure efficient and economical sanitation within their areas naturally desire? Suggestions have been made of late for the solution of this problem, and also for maintaining adequate supervision of works actually in progress or in operation. The whole subject will probably be considered ripe for discussion very soon, for at the present time a Royal Commission is investigating in an exhaustive manner the best solution of the sewage disposal problem.

In any case, the County Medical Officer of Health feels it to be his duty to refer to this aspect of the question. He has endeavoured in preparing this report to present as wide a grasp of the very complex subject matter as his long and varied experience in public health work has enabled him to acquire.

EDWARD C. SEATON, M.D.,

April 21st, 1899.

County Medical Officer of Health.

APPENDIX TO REPORT ON SEWAGE DISPOSAL WORKS IN THE
COUNTY OF SURREY.

Notes.—The following list includes almost all the Sewage Farms and Works in the County. Generally speaking, Works in progress (Carshalton for example) or those in a transitional state (Walton for example) have not been taken into account :—

				PAGES.
Beddington Sewage Farm	...	...	...	85
Epsom	„	...	...	85-7
Godalming	„	...	...	88-9
Camberley	„	...	...	89-90
Weybridge Sewage Disposal Works and Farm			...	90-2
Reigate	„	„	...	92-3
Esher	„	„	...	93-4
Guildford	„	„	...	94-6
Farnham	„	„	...	97-8
Ripley Sewage Disposal Area (1 and 2)...			...	98-9
Shere	„	„	„	100
Blechingley	„	„	„	100-2
Horley	„	„	„	102
Dorking Sewage Works	...	...	...	102-7
Cranleigh	„	...	...	107-8
Malden	„	...	...	108-9
Cheam	„	...	...	109-11
Tolworth	„	...	...	111-2
Molesey	„	...	...	112-3
Wimbledon	„	...	...	113-8
Sutton	„	...	...	119-23
Merton	„	...	...	123-4
Richmond	„	...	...	124-9
Kingston	„	...	...	129-32

It will be observed that the accounts which appear first in the list are those in which "Land Treatment," as originally advocated by Chadwick and Rawlinson, is closely followed. At the end of the list are those in which the principle of "Chemical Treatment" predominates more and more. Finally at Kingston, where the A.B.C. system is carried out, "Land" has no part whatever in the Treatment of Sewage.

The information on which the description of the several Works is based has been, with one exception—viz., that of Kingston—derived from written statements of the Surveyors of the District Councils and those who manage the Works for the several authorities to whom they respectively belong. Beyond the rough classification just referred to, discrimination is not carried very far. It would, indeed, be impracticable and undesirable at present to attempt to group the Works in this catalogue or inventory according to whether they are to be considered good, bad, or indifferent. All the data for such classification according to merits or demerits do not at present exist. Nevertheless, the Appendix is a first step towards the provision of such a catalogue as would serve for a *guide* to authorities. Moreover, if the accounts of Works are read in connection and with what has been said in the Report, those specially interested will be in a position to institute comparisons of their own, and will see what mistakes they should avoid in the future and what points require most attention.

Occasionally, when it is desired to draw attention to some special point, a note with the letters C.M.O.H. is introduced.

THE CORPORATION OF CROYDON COUNTY BOROUGH SEWAGE FARM.

THE BEDDINGTON IRRIGATION FARM.

Established 1860. Added to 1871, 1880 and 1894.

BOROUGH SURVEYOR: MR. THOMAS WALKER.

Situation and General Description of Works.—The Farm is in Beddington Parish, adjoining the Borough. The system is that of broad irrigation.

Whole Area devoted to the Works.—651 acres.

Areas for different purposes (e.g. Buildings, Tanks, &c.).—Area under irrigation, 450 acres. Land not irrigated, 181 acres. Plantations and buildings, 20 acres.

General Account of the system adopted, Size of Tanks, &c.—Broad and surface irrigation. Croydon sewage passes through a revolving screen.

Number and Character of Population.—About 100,000 of all classes.

Character of Sewage.—Chiefly domestic sewage, with several breweries.

Dry Weather Flow.—Three and a-half million gallons a day (24 hours).

Wet Weather Flow.—Up to twelve and even fifteen million gallons, occasionally, a day.

General Remarks.—The adoption of bacteria tanks in some shape is under consideration.

EPSOM URBAN DISTRICT COUNCIL. SEWAGE FARM.

Established

SURVEYOR: MR. CAPON.

The sewage farm belonging to the Epsom Urban District Council is situated on the north-east side of the District of Epsom, abutting on a portion of the west side of the Parish of Ewell.

The area of the farm is 126 acres, about one-half of which is very suitable land for the treatment of sewage, being loam overlying a bed of gravel and flints, of about 6 ft. in depth; the remainder is land of a very stiff nature.

About one-half of the land is commanded by gravitation ; the sewage is pumped on to the remaining portion by means of a 6 in. centrifugal pump. This is by far the best land for sewage treatment.

The sewage is received on the farm at four different points, being from different areas of the district ; no chemicals whatever are used, the sewage being allowed to pass through screening tanks, after which it then passes on to the land where required.

The sludge is run or pumped into lagoons formed of screened house refuse, and when sufficiently stiff is heaped and carted away on to the land, this makes good dressing, and crops flourish well on it for one year. It also is a great benefit to the stiff land making it work much more freely. This system of sludge collection is not in the Surveyor's opinion satisfactory, but undoubtedly as the district extends some other system will be adopted.

The land is under-drained and the effluents discharge into a brook down which it flows for about 1000 yards, when it joins the Hogsmill River, about 270 yards west of the South-Western Railway, at Ewell.

During several months of the year the effluents from the various outfalls (of which there are six) comprise the whole stream ; that part above the outfalls being dry, the appearance of the stream, at all times, is clear and free from smells.

The area devoted to irrigation is about 100 acres in extent.

The area covered by buildings, tanks, and filters is about 870 square yards.

The system adopted may be described generally as natural subsidence and broad irrigation, assisted by fine bacteria beds. The sizes of the tanks are as follows :—

1. 47 ft. 0 in. by 19 ft. 6 in. by 10 ft. 6 in.
2. 22 ft. 0 in. by 21 ft. 3 in. by 4 ft. 0 in.
3. 27 ft. 0 in. by 23 ft. 8 in. by 3 ft. 6 in.
4. 31 ft. 6 in. by 8 ft. 6 in. by 3 ft. 8 in.

And the sizes of the bacteria filters are :—

1. 60 ft. 0 in. by 40 ft. 0 in. by 3 ft. 6 in.
2. 50 ft. 0 in. by 40 ft. 0 in. by 3 ft. 6 in.

The number of population draining to this farm is from 10,000 to 10,500, and its character residential and working class.

The character of the sewage is domestic; there are one or two breweries discharging into the sewers, but the quantity of refuse from them is not very considerable.

The dry weather flow is about 500,000 gallons.

The wet weather flow depends entirely on the quantity of rain fall. This is very considerable, as unfortunately all storm water and overflows from several large ponds are connected with the sewers.

The land is cultivated by the Council under the direction of their Surveyor, and after allowing for a fair agricultural rent, rates and taxes, pays working expenses. Some excellent crops of wheat and oats have been grown—in 1897, $6\frac{3}{4}$ quarters of wheat per acre were grown, weighing $64\frac{1}{4}$ lb. to the bushel ; in 1898, 5 quarters per acre, weighing 66 lb. per bushel ; some part of the land this year yielded 13 quarters of oats to the acre.

Excellent root and vegetable crops are grown.

[This is a very good example of a sewage farm, properly so called, Some improvements are, however, required here, as at the Croydon Beddington Farm, in the structural arrangements, so as to allow of the work being carried out in a more cleanly fashion, and without nuisance.—C.M.O.H.]

The bacteria system has been adopted for a portion of Epsom Common. A population of about 250 persons drain on to the filters, the sizes of which are as follows :—

- Coarse beds—22 ft. 3 in. by 12 ft. 0 in. by 4 ft. 0 in.
 Fine beds —20 ft. 0 in. by 10 ft. 6 in. by 7 ft. 6 in.

The effluent which is bright and odourless, discharges into a ditch leading into the Rye on Ashtead Common.

GODALMING CORPORATION.

SEWAGE DISPOSAL WORKS.

Established 1895.

Added to 1898.

BOROUGH SURVEYOR: MR. NORRIS.

Situation and General Description of Works.—The Sewage Disposal Works of the Borough of Godalming are situated at Unsted, in the Parish of Shalford, about a mile outside the Borough boundary.

The soil of the Farm is suitable for sewage treatment, and is fairly open, except on the hill parts where the sub-soil is very compact.

The Farm belonging to the Authority (about 80 acres) has a northern aspect, and lies partly on the low land with meadows extending down to the bank of the River Wey, and extends up the side of the hill with about 20 acres on the top of the hill, about 150 feet above the level of the river.

There are pumping station, and other buildings in connection, also farm buildings, and two cottages for workmen.

Whole Area devoted to the Works —The total area of Works and Farm is about 80 acres, but irrigation is carried out only on about 30 acres, 14 of which are graded and underdrained.

Areas for different purposes (e.g., Buildings, Tanks, &c.).—The area of pumping station, buildings and yard in connection, is one quarter acre.

The area of farm buildings and cottages, &c., is half an acre.

The area of tanks and carriers is one-third of an acre.

The area of land filter beds, 14 acres.

The area of irrigated fields not under-drained, 16 acres.

General Account of system adopted, Size of Tanks, &c.—The sewage is first passed through a screening chamber and thence into a pump well. It is then lifted by the pumps and discharged through the rising main into one of a series of three settling tanks, each of which is 120 ft. long and 34 ft. broad.

At the end of the tanks, before passing over the weirs into the main carrier, the sewage proceeds downwards and upwards through coke screens.

The sewage is then conducted by the main carriers and distributed over the irrigation area, and after passing through the land the effluent is collected by the under-drains and discharged into the River Wey.

No chemicals whatever are used. The contents of each tank, after being worked for fourteen days are run off into sludge beds and allowed to become solid, and then carted on to the upper land or sold. [This plan of desiccating the sludge is generally carried on, without much offence, about the centre of the area, which is remarkably open and favourably situated. The material of the coke screens, which are not used on the biological principle, are also burnt here from time to time.—C.M.O.H.].

By shutting a valve on the rising main the sewage can be sent higher up the hill on to a grass meadow which is used as a relief when crops are growing on the filter beds.

Number and Character of Population.—The population draining to the Authority's sewers is estimated at 9000. On the hills there is a considerable residential population (including the Charterhouse), and in the valleys here is the usual trading community, together with a large number of people employed at the factories in the town.

Character of Sewage.—The sewage received at the outfall consists of domestic sewage with trade refuse from one tan-yard and works.

One leather mill.

One paper mill.

One steam laundry.

Dry Weather Flow.—The dry weather flow averages about 400,000 gallons per day.

Wet Weather Flow.—The wet weather flow averages about 450,000 gallons per day.

General Remarks.—The Council intend to lay out and under-drain a further 7 acres of land, and an application has been made to the Local Government Board, for permission to borrow the necessary money for the work.

FRIMLEY URBAN DISTRICT COUNCIL.

CAMBERLEY, SURREY.

SEWAGE DISPOSAL WORKS.

Established 1883. Altered 1896—9

SURVEYOR, MR. HODGSON.

The York Town Sewage Farm is on land adjoining the River Blackwater, and approached from Frimley Road, York Town.

The sewage, on entering the farm, is passed through settling tanks, and from thence by conduits or carriers on to the land, which is drained at depths varying from 3 ft. to 5 ft. ; the effluent, after passing through the land, enters the coke breeze filter beds at or near the bottom, and after a process of upward filtration is finally discharged into the River Blackwater.

The total area of land is $21\frac{1}{4}$ acres.

The quantity of land under cultivation is $11\frac{3}{4}$ acres ; it grows principally rye grass, mangolds, and osiers. Included in this quantity are the filter beds 500 ft. by 9 ft., two settling tanks 22 ft. by 11 ft. each, a wood shed and small stable.

The population of the drainage area is variously estimated at from 4000 to 5000.

The sewage is purely of a domestic character, there being practically no factory trade refuse in the district.

The average summer flow is about 180,000 gallons per twenty-four hours.

The average wet weather flow is about 460,000 gallons per twenty-four hours.

There is also a small farm at Frimley covering about 2 acres. This is worked under precisely similar conditions as above, the whole of which is laid down with grass.

WEYBRIDGE AND OATLANDS JOINT SEWERAGE. SEWAGE DISPOSAL WORKS.

Established 1895.

SURVEYOR, MR. CRAWSHAW.

Situation and General Description of the Works.—The sewerage of the Urban District of Weybridge and the Oatlands Ward of the Urban District of Walton-on-Thames was completed in June, 1895. The sewers, which vary from 6 to 18 inches in diameter, are about 19 miles in length and laid at self-cleansing gradients. The sewage gravitates to a storage tank at the pumping station, holding to the invert of the sewer 75,000 gallons, and from there it is pumped a distance of three miles through a 15 in. iron rising main to the Disposal Works near New

Haw, close to the village of Byfleet. The spot is close to the L. & S.W. R. main line, the whole area being visible to passengers. The sewage is there delivered into a channel 45 feet above the invert of the outfall sewer at the pumping station. About 21,000 gallons of river water is pumped daily from the Thames at the pumping station to supply the sixteen automatic flushing chambers, which vary from 500 to 5000 gallons capacity.

Subsoil water pipes are laid throughout the district below the level of the sewers and discharge into adjoining watercourses. By this means the subsoil water level has been permanently lowered. [Note this important fact.—C.M.O.H.].

Whole Area devoted to the Works.—The total area of the Disposal Works is 28 acres.

Areas for different purposes (e.g., Buildings, Tanks, &c.)— $24\frac{1}{2}$ acres are cultivated and the remainder occupied by the buildings, tanks, carriers, roads, &c.

Number and Character of Population.—The estimated population of Weybridge, in July, 1898, was 4800, and of Oatlands 1700, making a total of 6500. Both districts are strictly residential.

Character of Sewage.—The sewage is of a domestic character, but owing to the exclusion of all rain water, and the time occupied in pumping it to the Disposal Works, it is with great difficulty purified.

General Account of the system adopted, Size of Tanks, &c.—The system adopted for the purification is chemical precipitation and subsequently land filtration, and the following is a description of the process :—

The sewage, on its arrival at the Works, is treated with milk of lime (six grains of lime per gallon of sewage being used), and passing through an agitating weir is delivered into a Dortmund tank. The sewage then flows through channels to the settling tanks (three in number and each being 81,375 gallons in capacity), and receives on the way ten grains per gallon of Spence's alumino-ferric and five grains per gallon of sulphate of iron. After the sludge has been precipitated the effluent flows through carriers on to the land where required. [Note the fact that as much as 15 grains of chemicals is used per gallon, the sewage being strong and not at all fresh owing to the great distance it has to be pumped.—C.M.O.H.].

Dry Weather Flow.—The dry weather flow averages 160,000 gallons per day, or 25 gallons per head of population.

Wet Weather Flow.—The wet weather flow is only slightly more, as storm water is rigidly excluded from the sewers.

Effluent.—The effluent passes through the land and into a dyke surrounding the farm, and from thence into watercourses connecting with the River Wey. The Works being just above the principal London and Surrey Water Companies' intakes, the effluent is subjected to a rigid examination by the Thames Conservancy Board, but as yet no complaint has been received from them.

General Remarks.—The sludge is pressed into cake by an air compressor and the cake sold to neighbouring farmers for agricultural purposes. The crops grown on the farm are Italian rye grass and mangolds.

REIGATE CORPORATION.

SEWAGE DISPOSAL WORKS—EARLSWOOD.

Established 1868. Amended 1893.

BOROUGH SURVEYOR, MR. W. H. PRESCOTT.

Situation and General Description of the Works.—The Works are situate at Earlswood, about 2 miles to the South of Reigate and Redhill. Both towns have sewerage systems of their own, their main outfall sewers finally converging. The sewage is treated together with milk of lime and sulphate of alumina. The effluent, after passing over the land, finally discharges into a tributary of the River Mole.

Whole Area devoted to the Works.—The area of the Farms is 225 acres but only 175 acres are available for irrigation.

Area for Different Purposes (e.g., Buildings, Tanks, &c.).—The tanks engine house and other buildings occupy about $\frac{3}{4}$ of an acre. The sewage, on arriving at the Works, is first screened, the chemicals are then applied, the mixing being accomplished by baffling plates fixed in the sewage carrier. The tanks are six in number, each 81 ft. by 45 ft. by 6 ft., having sludge outlets in the centre. The effluent is drawn off by means of floating arms, which are so arranged that two-thirds of the effluent

can be syphoned to a distant part of the New Pond Farm, $\frac{3}{4}$ of a mile away. The sludge precipitated gravitates to a well, and is drawn from thence into pneumatic ejectors and forced by compressed air into the filter presses.

Number and Character of the Population.—The estimated population is 25,000.

Character of the Sewage.—The sewage is of purely domestic character. The refuse from one manufactory, a tannery, is received, and is said to have caused trouble.

Dry Weather Flow.—1,100,000 gallons.

Wet Weather Flow.—2,500,000 gallons.

General Remarks.—The Council have been much occupied of late as to the desirability of treating the sewage on biological principles. With this object in view, experimental filters have been constructed. The results, so far, have been satisfactory, but the works have not been in operation sufficiently long to allow of an opinion as to its future merits being expressed.

THE URBAN DISTRICT COUNCIL OF ESHER AND THE DITTONS.

SEWAGE DISPOSAL WORKS.

Established about 1890.

SURVEYOR, MR. HENDERSON.

Situation and General Description of the Works.—The sewage farm of the drainage area of the Esher and Dittons Urban District is situated on the extreme north-western boundary of Esher Parish on the banks of the River Mole, between the Linoleum Mills and the bifurcation of the Rivers Ember and Mole. The principle adopted in respect to the treatment of sewage is chemical precipitation (lime and alum), and intermittent downward filtration over specially prepared filtration areas, *i.e.*, the filtration areas are sub-drained into a main collecting drain, which discharges into the River Mole. A portion of the effluent, however, after being chemically treated and run on to the filtration areas, slowly irrigates through the grass and osiers, and finds its way to the outfall in the Mole by surface irrigation.

Whole Area devoted to the Works.—The whole area devoted to the Works is 24 to 25 acres.

Areas for different purposes (e.g., Buildings, Tanks, &c.).—The tank area is 750 square yards. The area devoted to buildings is about 30 yards. This includes engine houses, mixing sheds, coal bunkers, stores and workshop.

General Account of the System adopted, Size of Tanks, &c.—The system adopted in regard to the treatment of sewage has already been described. The main sewerage was intended only for sewage, but unfortunately a great deal of subsoil water finds its way into the sewers. The sewage is brought to the Outfall Works from Esher and Claygate by gravitation, the sewage of Thames Ditton and Long Ditton is lifted three times before it reaches the pump-well by means of automatic working pumps, actuated by hydraulic pressure from the engines at the sewage farm. There are three tanks for precipitation, each tank being 90 ft. in length by 25 ft. in width. The sewage, after chemical treatment, under cover, has a continuous flow through the tanks. Only two tanks are in operation at one period of time.

Number and Character of Population.—The population is estimated at 9000. The character of the population is principally residential with isolated areas of labourers' cottages.

Character of Sewage.—Highly diluted owing to immense quantity of ground water finding its way into the sewers in the low levels.

Dry Weather Flow.—About 820,000 gallons of sewage per day (24 hours).

Wet Weather Flow.—About 1,200,000.

[The enormous volume of the ordinary dry weather flow and the diluted condition of the sewage is very remarkable and very significant.—C.M.O.H.]

GUILDFORD CORPORATION.

SEWAGE DISPOSAL WORKS.

Established 1895.

BOROUGH SURVEYOR, MR. C. G. MASON.

Situation and General Description of Works.—The above Works are situate within one mile of the Borough boundary, in the Parish of Stoke, and in the neighbourhood of a small residential class of cottage property, called Bell Fields; they consist of 21 acres, securely fenced in on the west and northern sides, whilst the River Wey forms the boundary on the south-east side.

The Superintendent's house is close to the entrance gates, and commands a view of the whole works, whilst within 50 yards are the buildings, consisting of a press house and engine room, with the precipitation tanks about 20 feet distant.

The whole of the sewage of the town, before reaching the Disposal Works, has to pass through a 15-in. cast-iron syphon ; this syphon (which is about $\frac{3}{4}$ mile in length) is laid under the bed of the River Wey, and it crosses the bed of the stream in two places ; the sewage, on reaching the Works, flows down the affluent channel, in which is placed slabs of alumino-ferric, and from thence into the precipitation tanks, where the solids are drawn off into sludge pits. The clarified sewage then weirs on to the adjacent filter beds, is retained a short period in these beds, and is then discharged into the collecting channel, at the foot of bank surrounding the tanks and filter beds. It is subsequently distributed over the surface of land by the best means at present available ; from the land, the filtrate or effluent is collected by the under-drainage, and passed into the River Wey, at an outlet just below Stoke Lock.

The land used for irrigation is not now cultivated, and osiers will be the only product in the future.

A large quantity of lime is used for pressing.

Whole Area devoted to the Works.—The area devoted to the Works is just over 13 acres, but is very inadequately under-drained, and in the case of a small portion, viz., 2 acres, is not drained at all.

Areas for different purposes (e.g., Buildings, Tanks, &c.).—The buildings on the land, consisting of Superintendent's house, and garden, press house, engine shed, cover an area of 744 super. yards, whilst the precipitation tanks, filter beds, sludge pits, roads, &c., cover another area of $1\frac{1}{4}$ acres.

The precipitation tanks are three in number, measuring 70 ft. by 50 ft. by 5 ft.; each tank, therefore, is capable of holding 109,375 gallons, and the total capacity of the three tanks is 328,125 gallons.

The filters are six in number, measuring 61 ft. 3 in. by 24 ft. 9 in., which, multiplied by 6, gives a total super. area of 9096 super. feet.

The depth of the filtering medium (which consists of coke) is 3 ft.

Number and character of Population.—The population of the Borough is purely residential, consisting of 16,000 inhabitants. There are no manufactories, but there are three breweries, using the town sewers.

The brewery refuse is screened and filtered, the solid matter carefully excluded, but the difficulty of regulating the temperature of the liquid discharged into the sewers has still to be overcome.

Character of Sewage.—The sewage may be termed a strong sewage, the quantity of sludge being large in proportion to the dry weather flow.

Dry Weather Flow.—350,000 gallons daily.

Wet Weather Flow.—About 100,000 gallons in excess of the dry weather flow.

General Remarks.—The Council have applied to the Local Government Board for permission to raise a loan of £2,700, in order to place the Works on a more satisfactory basis, and it is proposed to expend this amount by carrying out the following works :—

The construction of three sets of bacterial filters, consisting of rough and fine filtering medium, constructed on biological lines, and capable of dealing with 170,000 gallons daily, the filtrate to be afterwards run into a distributing carrier, and discharged over the 13 acres of land available for that purpose.

A new 15 in. open distributing carrier is to be laid, and the surface of land so regulated that the filtrate from the new and existing tanks may be evenly distributed.

Thirteen acres of the adjoining land is to be again under-drained at a deeper level, the drains laid in closer contact than the existing drains, and to completely permeate the whole area at present available for irrigation purposes.

It is computed that these additional works will so relieve the existing precipitation tanks and filter beds, that the latter will be more able to deal satisfactorily with the clarified sewage.

[The sludge has been allowed to accumulate at these works. This is one of the causes of complaint that has unfortunately arisen. The proximity of the works to dwellings is an additional reason for the prevention of nuisances in connection therewith.—C.M.O.H.]

FARNHAM URBAN DISTRICT COUNCIL.

SEWAGE DISPOSAL WORKS.

Established 1885. Alterations 1898.

SURVEYOR, MR. ROBT. W. CASS.

Situation and General Description of the Works.—The Sewage Treatment Works consist of (a) pumping station, Guildford Road, and (b) farm in Water Lane, both in the Urban District on the east side of the town. The distance between the pumping station and the farm is about half a mile, and the farm is some 40 ft. above the level of the outfall sewer. The rising main is 12 in. diameter and will contain about 20,000 gallons; this rising main is always full, and remains so between the times of pumping. This is mentioned because it appears to add to the difficulty in disposal of sewage without smell during the process of pumping. The works at the pumping station consist of :—

(1) Two settling tanks with screening and subsidence apparatus or arrangements.

(2) Sludge well, chain pump and sludge carriers for lifting the sludge from tanks and well to prepared beds of domestic ashes.

(3) Engine and boiler house containing duplicate boilers and engines, together with duplicate sets of pumps; the engines are 15 horse-power each, and on the average lift about 20,000 gallons of sewage per hour.

Whole Area devoted to the Works.—Area of farm, 12 acres; subsoil, which is underdrained, consists of sand and gravel with a certain amount of iron, distinct traces of which appear in the effluent as yellow ferric oxide. Pumping station about half an acre, which is occupied by tanks buildings and sludge treatment beds.

Areas for Different Purposes (e.g., Buildings, Tanks, &c.).—Buildings occupy about 9 rods, tanks about 9 rods, sludge beds about $\frac{1}{4}$ acre.

General Account of the System adopted, Size of Tanks, &c.—The sewage is strained through screens three-sixteenths of an inch mesh, is then allowed to subside or settle, the liquid being pumped to farm and filtered through the land, the effluent discharging into a brook near Bourne Mills. The sludge is lifted from tanks as above described, and forthwith mixed and covered with dry domestic ashes which have previously been sorted

and cleansed for that purpose ; the final product of this process is sold to farmers as manure. The total capacity of the tanks is about 100,000 gallons ; but when the tanks are full the outlet of the outfall sewer is submerged to a depth of some 4 ft. 6 in., and the outfall sewer for a considerable distance is full, that is to say, that the outfall sewer can only be flushed when the tanks are almost empty.

Number and Character of Population.—The population of Farnham is about 6000 ordinary urban population (the town is a water-closet town).

Character of Sewage.—The sewage is composed of about equal proportions of domestic sewage and brewers' refuse.

Dry Weather Flow.—150,000 gallons per day.

Wet Weather Flow.—Variable, say on the average 250,000 gallons. The town is sewered on the separate system as far as practicable.

General Remarks.—The following factors render the manipulation of the sewage at the pumping station and at the farm, without causing smell, very difficult.

(1). The very large proportion of brewers' refuse, in an untreated state, being mixed with the town sewage.

2. The considerable distance between the farm and the pumping station—*i.e.*, contents of rising main become offensive and throw off gases when meeting the open at the farm.

(3). Difficulties arising from the outfall sewer being below tank capacity.

The Council are trying to get over these difficulties, and for that purpose are taking advice.

GUILDFORD RURAL DISTRICT COUNCIL.

Established 1878. Alterations various dates.

SURVEYOR, MR. J. DEWHIRST.

RIPLEY No. 1 OUTFALL WORKS.

Situation and General Description of the Works.—This is an enclosed portion of Homewood Farm, Ripley.

Whole Area devoted to the Works.—Consists of 2 acres.

Areas for Different Purposes (e.g., Buildings, Tanks, &c.).—The tanks and filters, &c., occupy about 300 square yards. Nearly $1\frac{1}{2}$ acres is for sewage disposal, and $\frac{1}{2}$ an acre, including subsidence pond, for storm water.

General Account of the System adopted, Size of Tanks, &c.—Osiers are grown on the $1\frac{1}{2}$ acres, which is partly trenched. Sewage is precipitated in two tanks working continuously, each 650 cubic feet capacity, then passed through one of three coke filters, each about 15 ft. long, 7 ft. wide and 1 ft. 6 in. deep.

Number and Character of Population.—This is estimated at 650. It is much increased on Saturdays and Sundays.

Character of Sewage.—Domestic and mineral water waste.

Dry Weather Flow.—750 gallons per hour mid-day from actual measurement, estimated to be 13,000 gallons per twenty-four hours.

Wet Weather Flow.—The 12 in. pipe runs full bore during heavy rains; all surface and rain water is admitted.

General Remarks.—The subsoil is clay. The Council are trying to obtain a more suitable outfall site.

RIPLEY No. 2 OUTFALL WORKS.

Established 1878. Alterations various dates.

Situation and General Description of the Works.—This is an unenclosed portion of Ripley Green, near the stream.

Whole Area devoted to the Works is a little over $\frac{3}{4}$ acre.

Areas for Different Purposes (e.g., Buildings, Tanks, &c.).—Irrigation, $\frac{3}{4}$ acre; the rest occupied by precipitation tanks.

General Account of the System adopted, Size of Tanks, &c.—Precipitation in five small tanks (covered underground), each about 100 cubic feet capacity. The sewage is then distributed over the $\frac{3}{4}$ acre of land.

Number and Character of Population.—Estimated at 200. Cottage property. Ordinary village population.

Character of Sewage.—Domestic.

Dry Weather Flow.—Estimated at 3,000 gallons per day.

Wet Weather Flow.—6 in. pipe runs full bore. Roof and surface water admitted.

General Remarks.—Soil is peat overlying gravel on clay, and is partly under-drained about 3 ft. deep.

GUILDFORD RURAL DISTRICT COUNCIL.

SURVEYOR, MR. J. DEWHIRST.

Established 1899.

SHERE OUTFALL WORKS.

Situation and General Description of the Works.—Near Shere village, in a plantation 70 feet above the village street.

Whole Area devoted to the Works.— $1\frac{1}{2}$ acres.

Areas for Different Purposes (e.g., Buildings, Tanks, &c.).—Bacteria tanks occupy 34 square feet. Remainder for irrigation.

General Account of the System adopted, Size of Tanks, &c.—Treatment in two sets of "Dibdin Bacteria" beds:—First Bed 12 ft. by 10 ft. 6 in. by 4 ft. 6 in. deep, second bed 12 ft. by 12 ft. by 2 ft. 8 in., then distributed by spade-cut carriers over land.

Number and Character of Population.—Estimated at 540, ordinary village population.

Character of Sewage.—Domestic.

Dry Weather Flow.—Not yet known.

Wet Weather Flow.—No rain or surface water admitted except from paved surface of three urinals.

General Remarks.—These are new Works, not yet in full work, subsoil sand and gravel not less than 14 ft. deep.

Should the bacteria system prove a failure, the first beds are designed as precipitation tanks, 12 ft. by 10 ft. 6 in. by 6 ft., and the second beds are designed as mechanical filters, 12 ft. by 12 ft. by 3 ft. 2 in., and would be worked as such.

BLETCHINGLEY.

Established 1895.

Situation and General Description of the Works.—The sewage of the village gravitates to a field situate near the village, which is laid out for sewage disposal purposes in the following manner, as described by Dr. Oldman, the able Medical Officer of Health, in his Annual Report for 1895 :—

The sewage first passes through settling tanks, provided with partitions so as to interrupt the flow as much as possible, and facilitate the deposit of its grosser portions. Then the partly clarified sewage is discharged on

to a specially-prepared and under-drained parcel of land, about one acre, and the filtered effluent collected by a series of subsoil drains, and conveyed into the brook.

The settling tanks are in duplicate, and so arranged that they may be worked alternately and enable the deposited sludge to be periodically removed without interrupting the flow of sewage on to the land. The flow through the tanks is even, steady, and continuous, the sewage passing under the first and over the second partition wall, and thence over a weir at the end of the tank. The tanks are provided with float boards to skim the sewage ; and the weirs at the inlet and outlet, by being the full width of the tank, ensure the regular delivery of the sewage, preventing a direct current through, and thus allow it to slowly move forward in a body and give every facility for settlement. The bottom of each tank is arranged with a cross fall, and has also a general fall towards the inlet end, where the greatest deposit always takes place ; and the sludge is discharged into a sludge tank, which is provided with a skimming valve to enable the surface water to be drawn off, leaving only the solid matter behind, which can be handled for sale or removed as manure. After passing through the settling tanks, the now partly clarified sewage is discharged on to the surface of the proposed land. This land is divided into two main sections, and each section is further divided into five bays, consisting of channels with intervening wide beds to permit of easy cultivation. A main carrier passes down the centre of the area, and is provided with an outlet to each bay, fitted with slide doors, by which the whole of the bays are under control, and any number in any position can be "laid off" for cleansing or aeration as may be necessary. Each bed has a subsoil drain down its centre, all of which are collected into an effluent sewer, by which the effluent is conveyed and discharged into an adjoining stream, being now quite clear. All junctions of subsoil drains to effluent sewer are made in open pits for inspection, so as to check the working of each bay. The channels are 2 ft. deep, but as the sewage will never be allowed to fill them to a greater depth than 1 ft., the line of saturation is kept well below the vegetables or plants growing in the beds. The sewage is uniformly applied to the land under treatment, part of it being carried by capillary attraction above the line of saturation to the

roots of the plants, and the remainder is efficiently filtered through the porous subsoil. The wide beds, whose surfaces are 1 ft. above the top sewage level, are well adapted for the cultivation of vegetables, and the amount applied is readily adjustable to all stages of plant growth.

One marked feature is the way in which a comparatively wet and boggy field has been dried and made suitable for filtration by the above special system of under-draining, whereby the subsoil water has been lowered from 2 ft. to 4 ft.

The population within the area of drainage is about 1000, and the amount of the loan applied for was £1500.

REIGATE RURAL DISTRICT COUNCIL.

SEWAGE DISPOSAL WORKS—HORLEY.

Established 1892. Altered 1898.

SURVEYOR, Mr. NIMROD WALTER.

Situation and General Description of the Works.—Lea Street, Horley.

Whole Area devoted to the Works.—About 30 acres.

Areas for Different Purposes (e.g., Buildings, Tanks, &c.).—

General Account of the System adopted, Size of Tanks, &c.—

Number and Character of Population.—About 3500. Residential and cottages.

Character of Sewage.—Purely domestic ; one small brewery.

Dry Weather Flow.—About 80,000 gallons ; but increasing every year.

Wet Weather Flow.—Uncertain. Several acres sometimes under flood water.

General Remarks.—The land is not unsuitable for sewage treatment ; but a mistake was made by putting in land drains. They have all had to be taken up to keep the sewage on the surface of the land.

DORKING URBAN DISTRICT COUNCIL.

SEWAGE DISPOSAL WORKS.

Established 1883. Altered 1893.

SURVEYOR, Mr. G. SOMERS MATHEWS.

Situation and General Description of Works.—The Works are at Pixholme, within a few minutes' walk of the Brighton Station, Dorking. The situation is very conspicuous, as it is not only visible from the side of

Box Hill, but at the foot of the embankment of the South Eastern Railway, near their Box Hill Station, and is consequently under the immediate view of passengers. The sewage of the town flows by gravitation to the Works.

The system adopted for the treatment of the sewage is known as precipitation by chemicals, with subsequent intermittent filtration.

Whole Area Devoted to the Works.—This is about 6 acres.

Areas for Different Purposes.—Timber and Buildings 1 acre, Upper Filtration Beds $2\frac{1}{2}$ acres, Lower Filtration Beds $2\frac{1}{2}$ acres.

Number and Character of Population.—The population is about 8000. In character it is that of an ordinary country town. The chief trades are in lime, corn, flour, and agricultural implements. Standing in the centre of a remarkably beautiful and interesting district, Dorking naturally tends to become more and more a residential place.

The Character of the Sewage.—The sewage is of a domestic character, and contains no brewery refuse. It appears to be fairly concentrated.

General Account of the System adopted, &c.—250,000 gallons of sewage is discharged daily into straining tanks (where the coarsest matter, about 3 cubic yards weekly, is removed by manual labour and given to farmers, who readily cart it away). Passing through the mixing house, the sewage is treated with a dose (ten grains to the gallon) of milk of lime from a 90 gallon liming machine, which is driven by a three-quarter nominal horse-power vertical (Stockport) gas engine. The liming machinery includes a miniature centrifugal pump, adapted for feeding the machine with the necessary amount of liquor to mix with the lime, and supplies a continual stream falling into the running sewage.

$1\frac{1}{2}$ cubic yards of ground white lime, costing 18s., is used weekly in this apparatus.

The gas engine is at work ten hours daily, including Sunday.

The cost of the liming plant, gas engine, &c., £212 10s.

Passing through the mixing house, the sewage flows over slabs of alumino-ferric towards the first of a series of four settling tanks, each

holding 50,000 gallons ; these are provided with galvanized iron wire cages, 3 ft. square, where any foreign matter escaping from the first straining tank is arrested.

The weight of the alumino-ferric used daily is $2\frac{1}{2}$ cwt., costing 7s. 4½d.

Each tank is supplied with a movable scum board, to further prevent the escape of floating matter.

The effluent rises over the weir of the first tank, and follows a channel leading to the second, third and fourth tanks, at which point it discharges into conduits leading to the filtration beds. By means of sluice gates, the settling tanks may be used separately, if desired ; upon other sluices being opened, the clarified effluent, after a few hours' quiescence, is drawn off, through floating arms, to within a foot of the floor of each tank. The whole of these tanks are thoroughly emptied once a week at least. The clarified sewage is discharged upon the upper beds, or it may, if desirable, be poured upon the lower ones. In emptying the tanks, the contents were formerly discharged solely on the lower plateau ; recent improvements, however, included one of Shone's pneumatic ejectors, by means of which the contents of the tanks may now be discharged at the rate of 200 gallons per minute upon the upper plateau, working with 10 lb. pressure of compressed air.

The ejector and its necessary adjuncts, comprising a Westinghouse direct-acting air-compressing engine, for compressing 40 cubic feet of free air per minute, to an average pressure of 5 lb. per square inch, at a 100 strokes per minute, also an air receiver, 9 ft. long, 21 in. diameter, with pressure gauge, &c., including connections with the existing vertical steam boiler, cost £372.

The lower plateau is $2\frac{1}{2}$ acres in extent, and was formerly used for growing osiers ; but the soil being mostly grey gault, proved unsuitable. This site has recently been excavated to a depth of 4 ft. 3 in., thoroughly drained, and reconstructed as artificial filters of coarse and fine gravel, sand and mould.

The main drains of each bed being 9 in. and the branch drains 6 in., Doulton's best London-made stoneware half-socket pipes, with open joints, were used, all the lines of drains being ventilated. These filter beds are used intermittently.

The surfaces of the filter beds are carefully scarified monthly, and twice a year the top spit is turned over to prevent the choking of the surface, as well as to secure the perfect aeration of the soil that is so essential in destroying the minute matters in solution.

The upper plateau contains $3\frac{1}{2}$ acres, and has undergone considerable drainage, owing to gault having been found also on this site ; the trenches containing the drain pipes have been carefully re-filled with layers of coarse and fine gravel, sand, and mould, to assist filtration. The surface of these beds are formed into ridges and furrows, upon which is grown mangold and other root crops.

Upwards of 60 tons of mangolds were raised during 1894, and disposed of at the rate of 13s. per ton.

Around each of the beds are open jointed drains, varying from 9 in. to 15 in. in diameter, 7 ft. deep ; these all converge at one inspection chamber, where the effluent runs over a marble weir in a white brick basin, and from thence into the River Mole.

After the effluent has been drawn off to within 12 in. of the floor of each tank, there remains the sludge, which gravitates through a 12 in. conduit beneath the tanks, to the sludge wells. By means of a 6 in. "Invincible" centrifugal steam pump, the contents (6000 gallons) of the wells are raised in less than an hour to receptacles constructed above the roadway ; ground lime is then freely used, and after the supernatant liquor has been drained off by lowering the penstock weirs, the sludge gravitates to "ram chambers" ; these are two in number, and are constructed so that all the parts may easily be taken to pieces and examined at any time. From the ram chambers the sludge is forced by compressed air into "presses" above.

To work the presses a steam engine is provided to drive the air compressor ; this is well balanced to prevent vibration, the air receiver itself forming a substantial foundation. Automatic gear is fixed to regulate the supply of steam in proportion to the amount of air required for pressing.

The filter presses, which are in duplicate, are constructed to stand many tons pressure between the plates, and the labour of opening and closing is accomplished by mechanical means, which is an important advantage in the manipulation of sewage sludge. It is worthy of note that no serious repairs have been necessary to any of the pressing plant supplied in 1887.

The press is composed of a series of 25 plates (2 ft. square) placed vertically, resting by means of lugs on two horizontal shafts, upon which they easily slide. At one end of the shaft a strong frame is fixed to support them and withstand the great power exerted during operation; at the other end is a heavy movable frame, by means of which the same accumulated air pressure as that which drives the sludge mass into the presses is brought to bear on the whole set of plates in each press.

When the press is closed it comprises a series of narrow vertical chambers, plates, and filter cloths on either side of the sludge under pressure, the total area for pressure purposes being equal to the size and number of the plates in the press.

The sludge is made to pass through the centre of the fixed end and into these chambers, where the separation of the solid particles from water takes place. The liquid, or water, runs through the filtering surface, and flows out by openings at the lower edge of the plates into a trough, and from thence to the upper beds. The pressure is kept on till the liquid ceases to flow, when the press remains full of solid matter, weighing 7 cwt. The operation generally occupies about three hours, varying with the consistency of the sludge to be pressed. The hand wheels are then loosened, and the end frame is moved by a piston acted upon by compressed air, thereby separating the plates one from another by sliding the same along the horizontal shafts.

The cakes of solid sewage are next allowed to fall into the waggon underneath, and the press is again closed automatically.

Ten cubic yards of pressed sludge is produced weekly; this substance has been sold at from 1s. to 10s. per yard, but the lower sum is probably nearest its agricultural value. As a fertilizer on light soils it has proved of considerable use. No difficulty whatever has occurred in disposing of the sludge; a neighbouring farmer agreed to take the whole of it for the year 1895, paying the sum of £18.

A cubic yard of pressed sludge weighs fifteen hundredweight. Two cubic yards of lime, costing 10s. per yard, are used weekly to further deodorise the sludge and to assist in the pressing operations. Half a ton

of steam coal and 18 bushels of coke are consumed weekly. Pressing is carried on four days each week. A set of canvas press-cloths last six weeks, and cost 72s., including making. The engine driver and gas engine attendant is the foreman; he is able to do repairs to machinery, and receives 35s.; his assistant earns 30s. weekly. Another man, 20s. weekly, is occupied about the tanks; a fourth, 18s., finds ample employment on the beds, where another is occasionally required.

Dry Weather Flow.—The dry weather flow averages 250,000 gallons. This gives about 30 gallons per head per day.

Wet Weather Flow.—

HAMBLEDON RURAL DISTRICT COUNCIL.

CRANLEIGH SEWAGE DISPOSAL WORKS.

Established 1887—8. Alterations 1893—9.

SURVEYOR, MR. EDWARD L. LUNN.

Situation and General Description of Works.—A low-lying situation, bounded on the west side by the high road from Cranleigh to Alfold Bars, and on the south by the stream or old river, being a tributary of the Wey. The works consist of precipitation tanks and small straining filters the sewage being lifted into the precipitation tanks from a sewage well.

Whole Area Devoted to the Works.—The whole area devoted to the works is 2·081 acres.

Area for Different Purposes (e.g., Buildings, Tanks, &c.).—The buildings, tanks and roadways about same occupy 0·333a., storm filters 0·206a. road and waste space 0·266a.; land, of dense clay, available for irrigation 1·276 acres.

General Account of the System Adopted, Size of Tanks, &c.—There is a sewage well 19 ft. by 10 ft. by 8 ft. 6 in. deep below inlet, two sludge wells, each 20 ft. by 15 ft. by 9 ft. 6 in. deep, two precipitation tanks, each 40 ft. 6 in. by 25 ft., two straining filter beds, each 25 ft. by 10 ft. The works, which were on the International Filtration Company's plan, were started in May, 1893. (See a letter to the ratepayers of Cranleigh by William Welch, Esq., January, 1894.)

Number and Character of the Population.—Population about 1580 estimated to be connected with the sewerage system, one large school included in the number.

Character of the Sewage.—The sewage is of the ordinary domestic character. One brewery.

Dry Weather Flow.—Estimated dry weather flow, 47,400 gallons per 24 hours.

Wet Weather Flow.—Wet weather flow was at the last gauging at the rate of 725,000 gallons during 24 hours, but since then a considerable volume of surface and subsoil water has been excluded.

General Remarks.—Arrangement for storm overflow consists of two coarse filter-beds average 37 ft. by 85 ft. each, composed of burnt ballast and coke breeze, worked intermittently with alternating gear.

The difficulties of the site have been found to be such that in spite of all efforts to improve existing conditions, it is at length found necessary to abandon it.

THE MALDENS AND COOMBE DISTRICT COUNCIL.

SEWAGE DISPOSAL WORKS.

Established 1887. Altered 1897.

The Works are situated to the west of the district, on the banks of the Hoggs' Mill River, which flows through Kingston lower down. [The site is unfavourable in other respects, and the land, which was never very suitable, has been in use many years now.—C.M.O.H.]. The sewage on its arrival at the Works empties into a storage reservoir of about 6 ft. diameter and over 100 yards long, holding 70,000 gallons. It is lifted thence into "continuous flow" precipitating tanks, being treated on its passage there, with lime, Sulphate of Alumina and Permanganate of potass. [The quantity of chemical used appears uncertain.—C.M.O.H.]. The precipitate or sludge is pressed. The effluent from the tanks (holding 262,000 gallons) overflows weirs and gravitates to furnace ash filter beds, where it is allowed to remain in contact with the filtering material at least two hours. The effluent is then let off and distributed over the irrigation beds for the purpose of oxidation, and finds its way through the land into a channel leading to the Hoggs' Mill River.

The whole area of the land is 8 acres. The irrigation beds, 5 acres 0 roods 16½ perches ; special furnace ash filters, 2200 square yards ; land, downward filtration beds, 5040 square yards.

The population is 5,621, mainly residential, and the sewage in dry weather is concentrated and requires careful treatment.

The dry weather flow, as far as ascertained, is 240,000 gallons per day (24 hours), and the wet weather flow 1,200,000 gallons per day.

The system has recently been enlarged by the addition of the District of Coombe and Old Malden, and the Works are not yet out of the contractor's hands.

[These Works will always require an exceptional amount of attention.—C.M.O.H.].

EPSOM RURAL DISTRICT COUNCIL. SEWAGE DISPOSAL WORKS AT WORCESTER PARK.

Established 1897. Altered 1899.

SURVEYOR, MR. WOOLDRIDGE.

The Sewerage and Sewage Disposal Works for the Parishes of Cheam and Cuddington were completed in the year 1897. [Nearly a quarter of a century, it will be noted, after the first inquiry by Mr. Arnold Taylor, on behalf of the Local Government Board (see the "Synopsis" in the Report of the County Medical Officer of Health for 1894). The reasons for the extremely tardy inception of the design and its admitted faults are probably identical.—C.M.O.H.]

The site of the Outfall Works forms the extreme north corner of the Parish of Cheam, where it joins the Parishes of Morden and Old Malden, and consists of about 8 acres, the subsoil of which is clay. The portion of land selected has a fall of about 18 ft. from the highest to the lowest point.

The following particulars are taken from a Memorandum on the original scheme of drainage laid before the Epsom Rural District Council by the Engineer appointed for the carrying out of the works in 1893 :—

The sewage is conveyed by gravitation to the farm by two main sewers. The high-level sewage, after treatment with chemicals (alumino-ferric), discharges into precipitation tanks, and the low-level sewage is pumped to the same point and treated with the high-level sewage in a similar manner.

After precipitation, the clarified sewage flows from the tanks over the land, [Stiff clay soil—C.M.O.H.] the latter being sub-soil drained. At the termination of the low-level sewer is constructed a receiving tank, below the outfall of the sewer. Pumping apparatus, worked by oil engines, raises this portion of the sewage to the precipitation tank, it is also employed to deal with the deposit or sludge from the precipitation tanks on the Filter Press System.

The Works were designed to deal with the sewage of about 4000 persons, the population of both Parishes being now estimated at 2790.

In the early part of last summer complaints began to be made of the condition of the Beverley Brook, into which the effluent from the Farm discharges, such effluent during dry weather providing by far the greater quantity of water flowing in the Brook. Later, owing to complaints becoming so numerous, and legal proceedings threatened by several of the adjoining local authorities and land owners, the Epsom Rural District Council decided to call in Mr. W. J. Dibdin, and upon his advice the Bacteria System for the treatment of the sewage, which contains a large quantity of brewery refuse, was adopted.

The present method of treatment consists of turning the crude sewage, without receiving any previous treatment other than passing through screens to collect paper, rags, &c., on to coarse bacteria beds, seven in number, of a total superficial area of 1117 yards, and of an average depth of 2 ft. 3 in. ; the effluent is then turned upon fine beds after the manner of the Sutton treatment. The fine beds are also seven in number, and have a total superficial area of 1214 yards of the same average depth as the coarse beds.

These bacteria beds have been formed by digging out the clay on the site of the beds, and well puddling the bottoms and sides, the clay burnt, and the ballast, after passing through sieves of various sizes, forming the material for the coarse and fine beds.

The effluent from five of the fine beds is collected into a pond, the bottom of which is filled with fine ballast through which the water passes, and by means of syphon pipes discharges at a level equal to that of the surface of the water in the pond, and thence flows over about an acre of ground before entering the Beverley Brook.

The effluent from the two remaining pairs of beds, which are apart from the other five pairs, will be treated in a similar manner, and afterwards flow over about one-third of an acre of land before entering the Brook.

The quantity of sewage treated during dry weather is about 60,000 gallons daily. The wet weather flow amounting to about 200,000 gallons per day.

The storm water can either pass through the beds or be distributed over about 4 acres of land as occasion requires.

The remainder of the land, about $2\frac{2}{3}$ acres, is taken up with roads, buildings, tanks, &c.

[It will be gathered that the whole history of this project of a "Sanitary Authority" has been unfortunate throughout. It is hoped that the remedies may prove effectual, but the scheme was an indifferent one to begin with, though it was said to be the only one available for the district.—C.M.O.H.]

SURBITON URBAN DISTRICT COUNCIL. TOLWORTH.

Established 1889. Altered 1897—8.

SURVEYOR, MR. SAMUEL MATHER.

Situation and General Description of the Works.—These Works are situated in Red Lion Lane, Tolworth. The area of the special sewage district, comprising Hook, Tolworth, and Southboro', is about 1859 acres.

The whole Area devoted to the Works comprises 8 acres.

The Areas for different purposes (e.g., Buildings, Tanks, &c.) comprise one-quarter acre.

General Account of the System adopted, Size of Tanks, &c.—The system is that of precipitation and intermittent downward filtration through the land. There are three settling tanks, 60 ft. by 20 ft. by 5 ft. 6 in.

Number and Character of Population.—The population is about 2400. The district is of a rural character and contains small properties.

Character of Sewage.—The sewage is of the ordinary domestic kind. There is no manufacturing or chemical discharge.

Dry Weather Flow.—This is 161,000 gallons per diem.

Wet Weather Flow.—This is 417,000 gallons per diem.

General Remarks.—The land has been thoroughly cleansed and under-drained during the past 18 months, and the filtering areas are being periodically ploughed up and the heavy ground mixed with town refuse. [This is another example of a scheme which was possibly the only one for the district, but which is always likely to tax the resources of the Council and its advisers—C.M.O.H.]

EAST MOLESEY URBAN DISTRICT COUNCIL.

MAIN SEWERAGE AND SEWAGE DISPOSAL WORKS.

Established 1895. Improvements 1896—8.

SURVEYOR, MR. JNO. STEVENSON.

Situation, General Description.—Situated on the extreme south-western boundary of the Parish, in a secluded spot. The site is on an average level of 34·50 feet above Ordnance datum, between the River Mole and the Weald River.

Total Area.—8 acres.

Buildings, Tanks, Roads, Embankments, &c.— $1\frac{3}{4}$ acres.

Filtration or Cultivation Area.— $6\frac{1}{4}$ acres.

System Adopted.—First, precipitation in tanks (lime, sulphate of alumina, and sulphate of iron used for treatment), the clarified sewage is then passed through the land by intermittent downward filtration.

Population Connected and Character of Sewage.—Population 5000. Chiefly residential ; one steam laundry and several smaller laundries.

The Daily Average Dry Weather Flow, taken all through November, 1898, was 117,896 gallons, or equal to $23\frac{1}{2}$ gallons per day of 24 hours.

The Wet Weather Flow, taken for one week in January, 1899, which was a fairly wet week, as well as the sub-soil water being well up in the ground, was 132,785, or equal to $26\frac{1}{2}$ gallons per head per day of 24 hours.

General Remarks.—The main sewers have worked very efficiently since they were commenced to be used in November, 1895.

Quite 90 per cent. of the houses in East Molesey Ward have been connected with the sewers, the supervision of which has been carried out by the Surveyor.

[It is instructive to compare these works with others in the neighbourhood. Great credit is due to the District Council and the Surveyor for the careful way in which the house connections have been made, and the consequent exclusion of subsoil water from the sewers. Owing to the low-lying condition of the land and the frequent flooding of the River Mole, adjoining the site, the treatment has required very close supervision to deal with it in a satisfactory manner. The Effluent Drain is unfortunately obliged to be covered and is three quarters of a-mile long!—C.M.O.H.]

WIMBLEDON URBAN DISTRICT COUNCIL.

MAIN SEWERAGE AND SEWAGE DISPOSAL WORKS.

Established 1876. Improvements 1881—99.

SURVEYOR, MR. COOPER.

Situation and General Description of the Works.—These Works are situated on the area of land south of and bordering on the South Western main line between Earlsfield and Wimbledon. From the railway, the trenched areas for cultivation and filtration, the pumping station and sludge-pressing works situate in the Durnford Road, the adjoining tanks, the contact beds in use and those in preparation, are all immediately under view.

The following general description of drainage outfall works given by Mr. Cooper, the well-known Surveyor to the Urban District Council, is specially interesting and instructive.*

With few exceptions, the roads at Wimbledon contain separate sewers for sewage and rainfall, the latter being conveyed by a system of outfall sewers to the natural watercourses. These sewers take the drainage from the road gulleys and the rainfall from the fronts of the houses. It has not been thought desirable to duplicate drains at the rear of houses.

* "Municipal Work at Wimbledon." Paper read before the Incorporated Association of Municipal County Engineers, 1898.

The following is a list of the intercepting sewers which take sewage to the Sewage Farm and Works. Branch sewers are not included :—

Name of Sewer.	Length in yards, not including Branch Sewers.	Population drained.	Daily Dry Weather Flow in Gallons.
High level ...	4900	4200	252,000
Middle level ...	6053	6000	180,000
Low level ...	6060	26,000	700,000
Summerstown ...	1160	230	5200
Totals ...	<u>18,173</u>	<u>36,430</u>	<u>1,137,200</u>

The high-level and middle-level sewers gravitate to the sewage works.

The low-level and Summerstown sewage has to be raised at the Works. The low-level sewage is raised an average of 22 ft. by two pumps raising 166 gallons each stroke. Each pump is actuated by a 16-horse power horizontal engine. The steam for the engines is produced in one of two Lancashire boilers, 20 ft. in length and 6 ft. diameter, the pressure of steam generated being between 45 to 50 lb. per square inch.

The low-level sewer, as constructed, was so defective that the late Board, by Mr. Santo Crimp's advice, reconstructed the greater part of it, and in order to provide self-cleansing sewers in Cottenham Park, and to take the sewage of Warren Farm, the Raynes Park pumping station was erected. The sewage is raised at this station 33 feet. There are two pumps, having one 12-in. diameter plunger with 24-in. stroke, worked by one of two $3\frac{1}{2}$ horse-power Otto gas engines; by means of a loose shaft either pump can be coupled up with either engine. The power is transmitted by cog gearing, the wheel having wood cogs.

The Summerstown sewage is raised by two 50-gallon Shone's ejectors.

Whole Area devoted to the Works.—This amounts to 73 acres.

Areas for Different Purposes.—The following table gives the areas devoted to the various parts of the Works:—

	ACRES.
Tank and buildings ...	2·62
Roads and land not devoted to sewage ...	4·50
Storm water filters ...	2·10

	ACRES .
Cultivation filters	2·00
Irrigation ground for first run	32·75
Ditto, second run	24·50
Now occupied by temporary hospital	4·75
Total	<u>73·22</u>

The area under the various crops may be thus given :—

	ACRES.
Rye grass	34·12
Osiers	15·0
Mangel wurzels and market gardening	10·24
Total under crops	<u>59·36</u>

General Account of the System adopted.—(A) High-level Tank and Filters.

—The sewage brought by the high-level sewer enters the bottom of the receiving chamber of the two high-level tanks. The sewage that flows into the tanks is drawn from the top of the chamber by one of two pipes, down which it flows, and so enters one of two tanks above the invert; each of these tanks has a floor of 2 in. by 2 in. battens placed 1 in. apart, carried on joists. On this floor there is about 5 in. of broken brick, about 2½ in. gauge, which forms a screen through which all sewage that enters the tank must flow in an upward direction. If greater depth or smaller material is used, the sewage comes up only in certain places, so that the flow is not evenly distributed over the tank. This system arrests all the grosser matter and almost all the suspended matter found in sewage, without the addition of chemicals. The tanks and filters are cleansed once a week, the sludge, &c., gravitating to the settling tanks at the sewage works. The effluent from these tanks is run twice over land before passing into the river. These tanks are each 30 ft. by 20 ft., with an average depth of 7 ft. As constructed, it was impossible to allow these filters to aerate, nor was any provision made for emptying the syphon which conveyed the sewage to the tanks. In 1894, the tanks were altered so as to allow one tank to remain empty whilst the other was working, and at the same time lowered the syphon outlet as much as possible.

The remainder of the sewage flows direct to the sewage works, where sufficient proto-sulphate of iron is added to the low-level sewage before it is pumped to allow four grains per gallon for all the sewage to be treated; twelve grains of lime per gallon is afterwards added to the sewage in bulk. The sewage thus treated passes along a conduit into one of six settling tanks which communicate by weirs, and each of which is fitted with a floating arm and sludge outlet, so that they can be used separately or in series. Each tank is 50 ft. by 49 ft., by 7 ft. 6 in. deep, and contains about 92,000 gallons of sewage, or 552,000 in all. Every week day one of these tanks is cleaned out, the sludge being run into the sludge reservoir.

The tank effluent, as a rule, passes off over a weir at the end of the last tank, and into a series of cast-iron distributing mains laid about 3 ft. beneath the surface, or it can be drawn off by the floating arms which communicate with the same mains. From these mains the tank effluent can be run either on to irrigation ground or cultivation filters. The effluent from the ground or filters is again run over land before passing into the river.

Filters.—As there is no possibility of acquiring land to cope with the increase in sewage due to the increase of population, the nitrifying capacity of the land has to be increased by converting it into filters.

The first filter was constructed in 1876, of burnt ballast, 3 ft. deep, and is still in use both for storm water and at times as a cultivation filter.

In 1893, an extension was completed of 2,900 yards super. to the storm water filter, and a cultivation filter of 5,300 yards super. Both filters were constructed of the material excavated on the site, the clay having been burnt to form the ballast.

The ballast was passed through sieves, the large material being used to form the filtering material, which in both filters was 3 ft. deep; in the storm filter this material was left uncovered, whilst the cultivation filter was covered with a layer of 9 inches of fine burnt ballast and a layer of soil 7 in. thick. In the storm-water filter the subsoil drains were placed 6 ft. apart, whereas in the cultivation filter the drains were 10 ft. apart.

As first constructed the subsoil drains from the cultivation filter discharged over an open channel, but as it was thought desirable to try the filter as a tank, this channel was abandoned, and the drains connected with one main drain discharged into a valve chamber. The filter, however, did not give such good results as with the drain outlets open for the passage of air. Ventilation has lately been provided by carrying up the drains at the highest points.

A second cultivation filter, similar to that just described, was completed this year, and ballast is now being burnt for two acres of cultivation filters, which will be placed at such a level as to take the effluent from the existing cultivation filters.

It is proposed to construct a carrier, 2 ft. 6 in. by 2 ft., to take the effluent from the existing filters on to the proposed filters on lower ground.

A tramway of 2 ft. 6 in. gauge is to be carried on piers over this carrier, to take road debris and other refuse on to the lower land, which requires raising. The inclination (1 to 202) is sufficient to gravitate the truck, which will be brought back by an electric locomotive worked from an overhead wire.

Mr. Cooper dwells on the fact that, with the exception of 6 acres near Earlsfield, the farm is on stiff clay. When the present farm manager, Mr. J. Snook, took charge in 1879, the effluent from this farm came off quite as polluted as the raw sewage, which was due to no attempt having been made to prevent the sewage soaking direct to the drains. Mr. Snook soon obviated this among other defects, and showed that sewage can be cleansed on clay ground. House refuse and sludge cake have, with the best results, been dug or trenched in from time to time, so that there is now 12 inches in depth of fair soil, where formerly none existed.

Sludge.—The sludge, as before mentioned, passes from the settling tanks into the sludge reservoir, which has a capacity of 6,700 cubic feet; the top water is drawn off by a weir. The sludge from the reservoir passes through a 6 in. pipe to the rams in the press house. There are three of these rams. Whilst the sludge is passing through the 6 in. pipe just mentioned, hot ground grey chalk lime is added in the proportion of 1·1 per cent. to the tank sludge.

Air at a pressure of 80 lb. is supplied to the rams by a double-acting tandem air compressor. A double tandem compressor is about to be fixed ; both the compressors to be placed in the engine room at the pumping station.

The waste air from a ram, when empty, can be used to do the mixing and first part of the pressing in the other rams, and is also used to work the ejectors to further facilitate the utilisation of waste air. Two air receivers are about to be erected.

There are four sludge presses

About 100 tons of sludge cake is produced weekly. As there is now no demand for such product, it is proposed to erect destructors in connection with the electric light station, to consume both cake and house refuse.

COST OF PRESSING PER TON OF CAKE.

						d.
Lime	...	...	...	...	...	7.15
Cloth	...	...	...	...	...	2.35
New plates	...	...	...	...	...	.68
Sundries	...	...	...	...	...	.12
Coal	...	...	...	...	...	3.53
Oil and waste	...	...	...	...	...	.59
Wages	...	...	...	...	...	9.84
						<hr/> 2s. 0 $\frac{1}{4}$ <hr/>

The Number and Character of the Population.—This is very different, according to whether the population draining to high or low level systems is considered. The former might be classed as residential, the latter artisan and wage-earning. The houses of both districts are water-closeted, but the sewage of the former class would be largely diluted with bath water, while that of the latter would be more concentrated. The whole population in 1898 being 36,000, that of the high level is only 10,000, while that of the low level is about 26,000. The stronger sewage would therefore be twice in volume of the weaker. On the whole the sewage is probably strong in character.

The Daily Dry Weather Flow is given at 1,137,200 gallons.

SUTTON URBAN DISTRICT COUNCIL.

SEWAGE DISPOSAL WORKS.

Established 1893. Improvements 1896—9.

SURVEYOR, MR. CHAMBERS SMITH.

These works are situate $1\frac{1}{2}$ miles North by West of the Sutton Railway Station. They are close to the cemetery. They were laid out in the year 1891-93, and were originally designed for chemical precipitation and broad irrigation. The site of the Works is covered with porous clay.

The area enclosed for the whole Works is 25·17 acres.

The area of the Works which may be irrigated from (1) the precipitation tanks, or (2) the coarse bacteria beds, equals 15·65 acres.

The area which may be irrigated from the fine grain bacteria beds equals 10·27 acres.

The area occupied by roads and buildings equals 6·52 acres.

The area which cannot be irrigated equals 3 acres.

The total area under cultivation equals 18·65 acres.

See description of bacteria filters, &c., herewith, which is a copy of a report which has been written by Mr. Chambers Smith for a published book.

The following crops are now under cultivation :—

Peppermint	...	...	...	...	4	acres.
Osiers	...	...	...	...	2·15	„
Cabbage	...	...	...	...	2	„
Rye and Tares	...	...	...	...	5	„
Rye and Clover	...	...	...	...	2	„
In fallow	...	...	...	...	3·40	„

A brief notice of the cultivation of peppermint may be useful. This plant (*Mentha piperita*) is very successfully cultivated, and the 1898 crop produced a gross revenue of £35 per acre. From the plant is produced by distillation the oil of peppermint of commerce.

The population of the district is 16,000. The district may be described as purely residential.

The sewage is of the domestic class. There are several laundries and dye works, which, however, contribute to the flow.

The daily dry weather flow equals 400,000 gallons per day, increasing in times of storm to 1,000,000 gallons per day.

The effluent is discharged into a stream of small volume, the Pyl Brook.

The Council are at present constructing additional bacteria beds or filters.

DESCRIPTION OF THE BACTERIA TANK BY MR. CHAMBERS SMITH.

A complete system of sewerage and Sewage Disposal Works was carried out at Sutton in 1891-93, at a cost of £55,000, the method adopted being the chemical treatment of the sewage by precipitation and broad irrigation. The quantity of sewage to be treated was estimated to amount to 500,000 gallons per diem, and flows by gravitation to the Disposal Works. One-fourth of this volume—viz., the low-level service—has, however, to be pumped at the outfall in order to be passed over the farm or through the artificial filters. The daily dry weather flow of sewage is 400,000 gallons. The population of the district is estimated at 16,000, the population draining to the Works being about 13,090. The sewerage of the district is “on the separate system.”

The sewage disposal works comprise an area of 28 acres of land—18 acres of which only are capable of sewage treatment—and this area is composed of stiff clay, which is ill-adapted for sewage purification. Complaints as to the ineffectual purification of the sewage led the Council to adopt additional means for the purpose, and eight coke breeze, &c., filters were consequently constructed for the filtration of the sewage after chemical precipitation.

The unsuitability of the soil for the efficient purification of the sewage and the cost of chemical precipitation and sludge pressing compelled the District Council to turn their attention in the direction of other modes of treatment.

It was resolved to try the experiment of treating a portion of the sewage by passing it through a coarse ballast filter, and as a result, the Farm Committee were advised that the system was one which ought to be tried at Sutton.

An experimental bacteria tank or filter—the first of its kind in the Kingdom—was accordingly constructed, the tank being intended for the treatment of crude sewage without previous treatment by chemicals or precipitation, the sewage being turned on to the filter directly it leaves the outfall sewer, except that it is passed through roughing screens to intercept floating matter, such as paper, &c.

One of the precipitating tanks was utilised for the purpose, the floating arm being removed, and the main effluent pipe used to draw off the filtrate.

The construction of a crude sewage filter (or “bacteria tank,” as it was termed) was commenced early in November, 1896.

The mode of construction of the filter was as follows:—On the floor of the tank, which has an area of $188\frac{1}{2}$ super. yards, was laid a 6 in. main trunk drain, with 3 in. branch drains, 19 in number, laid from the main, running down the centre to the side walls. The main effluent pipe is provided with a 6 in. valve, which is a necessary adjunct, so as to be shut down when the tank is being filled, and the valve is enclosed in a chamber for ease of access. On the pipes being laid, the joints, which are left open, were covered with the coarsest ballast, and the tank was then filled up with ballast burnt from the clay which, as before stated, covers the whole site of the farm, the average depth of ballast in the filter being 3 ft. 6 in.

In filling the filter with the ballast, care was taken to exclude all dust and material, which passed through a screen of $\frac{1}{2}$ in. mesh. The following figures may be interesting and useful:—The area of the crude filter or bacteria tank is $183\frac{1}{2}$ super. yards; the capacity of the crude filter or bacteria tanks is 218 cubic yards; the capacity of the filter without ballast is 36,064 gallons; the capacity for sewage of the filter with ballast is 13,500 gallons, the proportions being approximately one-third sewage, two-thirds ballast; the flow of sewage applied per superficial yard per day is 186 gallons; the flow of sewage applied per cubic yard per day is 138 gallons; the flow of sewage applied is at the rate per acre per day of 900,240 gallons. The first bacteria tank has been practically in daily work since the 21st November, 1896, treating, on an average, 30,000 gallons per day, the resultant filtrate being generally free from odour, the filter being charged twice and sometimes three times per day.

The whole of the sewage flow, without any chemical treatment, is turned directly on to the bacteria filter, the sewage having been passed through roughing screens to intercept the larger pieces of paper. Recently an automatic rotary screen, driven by a Poncelet wheel, actuated by the sewage flow, has been adopted with satisfactory results. The time occupied in filling one bacteria tank or filter is about three-quarters of an hour, and care is taken to prevent the sewage heading up or ponding above the surface of the filter, the flow being stopped as soon as the sewage level reaches to within a few inches of the surface of the ballast. The filter is then allowed to remain charged for two hours, after which the valve is opened and the filter is emptied, the time occupied in the latter process being about one and a-quarter hours, the filtrate being then passed on to the secondary filters or over the land when any portion requires irrigating. The bacteria filter is then allowed a rest of two hours, after which it is again charged, the cycle occupying six hours.

The action of the filter is biological, the sludge being absorbed by the action of bacteria in the filter, 57·2 grains of matter per gallon being on the average removed. The effluent from the second bacteria filter, which is composed of finer material, is uniformly clear and bright, almost resembling the majority of ordinary drinking waters, and this is generally turned into a brook of small volume without any further treatment whatever. The purification effected by the combined filters works out as follows :—98·79 per cent. of matter in suspension removed ; 85·83 per cent. of oxygen absorbed in four hours ; 78·54 per cent. of reduction of nitrogenous organic matter as indicated by the albumenoid ammonia.

The first crude sewage or coarse bacteria filter has been working regularly since November, 21st 1896, 12,250,000 gallons of sewage having been treated up to January, 1897, and 443 tons of sludge absorbed without any nuisance and at but little further cost than the opening and closing of the valves for the charging and discharging of the filters, and this latter appears to be in as good condition now as when it was first started, the filtering material itself being without more offensive odour than that of fresh garden mould.

A second tank has been converted into a bacteria filter, and started in work on May 30th, but in this case the filtering material was laid in layers of varying degrees of fineness, the lower layers being

the finest, and increasing in coarseness to the surface, the depth of material being 5 ft. 6 in.; and although the cost of this filter is greater than the first, owing to extra labour involved in screening, the results hitherto have not been found superior to the first filter constructed. Four coarse grain bacteria filters have altogether been constructed. At the present time 230,000 gallons of sewage are being treated daily by the biological filters.

[The above description is entirely by Mr. Chambers Smith. The C.M.O.H. has made several visits to the Sutton Works, and has reported thereon independently at various times to the Committee. The chief feature about these works is the co-existence of different available methods of disposing. The remarks in the body of the Report on varying kinds of sewage and opportunity for selection in treatment may be reverted to in this connection.]

CROYDON RURAL DISTRICT COUNCIL. MERTON SEWAGE DISPOSAL WORKS.

Established 1881. Altered 1898.

SURVEYOR, MR. R. M. CHART.

Situation and General Description of the Works.—The Works are situate at Byegrove Road, partly in Parish of Mitcham and partly in the Parish of Wimbledon, the bulk of it lies on east bank of the River Wandle between Merton and Garrett.

Whole Area devoted to the Works.—The total area is 40 acres.

Areas for Different Purposes (e.g., Buildings, Tanks, &c.).—Of the above area, 28 acres is devoted to the Works and filtration area, the remaining 12 acres being river and meadow not utilized in the purification of sewage. Of the 28 acres, $\frac{3}{4}$ of an acre is now occupied by three precipitation tanks, $1\frac{3}{4}$ acres by artificial coke breeze filters, and $1\frac{1}{2}$ acres are occupied by the buildings, yard and approaches.

General Account of the System adopted, Size of Tanks, &c.—The original Works were established in 1880 for treatment by intermittent downward filtration, and were so used until 1897, when it was found necessary, owing to the increasing population and the difficulty of producing a satisfactory effluent on so limited an area, to change the character of the treatment.

Accordingly, in 1897, the Council decided, on the advice of Mr. Chatterton, the well-known Consulting Engineer, to expend £17,000 on constructing precipitation tanks and artificial filters of coke breeze and shingle ; these were brought into work in September, 1898.

The sewage is now treated with lime and sulphate of iron in the tanks, and then passed through the filters, which are worked intermittently ; the effluent from the filters is reported upon by Dr. Stevenson, the County Analyst, as fit to be discharged into any river not immediately used for obtaining water for dietetic purposes. The land remaining is used for further purification by irrigation or downward filtration.

The sludge resulting from the precipitation is pressed into sludge cakes, and dug into the meadow land on west side of the river.

Number and Character of Population.—The population draining to these Works in 1891 was 22,000 ; it is estimated that the population now draining thereto is 32,000 ; it is very varied in character, the district being residential, agricultural, and manufacturing.

Dry Weather Flow.—The dry weather flow is $1\frac{1}{2}$ million gallons in 24 hours, and with a rainfall of $\frac{1}{2}$ in. in 24 hours *it reaches about 4 million gallons.*

General Remarks.—Under the intermittent downward filtration system, the effluent, although good, contained very large quantities of sewage fungus, which was abstracted to some extent by means of coke filters before the effluent discharged into the river. Since the precipitation works have been established, the character of this has begun to change. The fungus, although still present, is much less in quantity and less rank in growth, and it is hoped that in time it will disappear altogether.

RICHMOND MAIN SEWERAGE BOARD'S WORKS.

Established 1891. Additions subsequently.

In the "Proceedings of the Incorporated Association of Municipal and County Engineers," Vol. XXII., 1895-6, an instructive account of these works is given by Mr. William Fairley, Assoc. M. Inst. C.E., F.G.S. Engineer to the Board. The following extracts, which are descriptive of the Works, are quoted almost *in extenso* :—

Situation and General Description of the Works.—The Board, in addition to the pumping station, precipitation works, &c., have about five miles of deep-level intercepting sewers.

These sewers are laid at such a level that the sewage of the whole district can be intercepted, and gravitate to the works at Mortlake.

The sewers vary in size from 12 to 40 inches in diameter, and are constructed of brick and cement, stoneware piping and concrete, and where along the river front under the towpath, of cast-iron pipes.

The gradients vary from 1 in 250 to 1 in 1200.

River water can be admitted at several points for the purpose of flushing.

As a great portion of the district is not much above the level of high water in the river, no overflow can relieve the sewers during rain storms at such a time. Overflows have, however, been constructed at two points, and additional overflows are in progress. The usefulness of these overflows is of course limited to the time when the river water is below or about half-tide.

The Works at Mortlake are about a mile from Mortlake Station, and are approached by the West Hall Road. They are situated close to the River Thames, which becomes a tidal river at this point.

The Whole Area of land purchased by the Board was 11 acres. Of this, however, only 8 acres are enclosed, the remainder being in the occupation of a market gardener.

The works include a range of buildings containing all the necessary appliances for pumping sewage, carrying out the necessary operations for chemical precipitation, and for pressing the sludge by means of filter presses.

Cottages are also attached for the employees, together with stables; also dock and wharf for the unloading of goods.

General Account of the System adopted.—There are eleven precipitation tanks, each 100 ft. by 30 ft. by 7 ft. 6 in. deep from the top of coping, the capacity of the whole being about 1,210,000 gallons; they can be worked either on the intermittent system or with continuous flow.

The walls are of Portland cement concrete, faced with blue Staffordshire bricks, the division walls being 2 ft. 6 in. thick.

The coping is formed of specially made blue Staffordshire coping 12-in. deep.

In addition to overflow weirs, each tank is fitted with the usual discharge pipe with floating arm. These floating arms are fitted with two outlet pipes, one of which draws the water in the tanks down to a level of about 3 ft. below top water level, and delivers into a channel commanding the high-level filters; the remaining depth of water in the tank being drawn off by a low-level outlet and delivered by a low-level channel to another set of filters.

The tanks are fitted with scum boards fixed at the weirs, and a wrought-iron gangway runs from one end of the tanks to the other, in such a position that the whole of the valves may be worked in stormy weather without risk to the workmen.

The effluent water from the tanks can be led on to eight filter beds, four of these are at a high level, and are each 107 ft. by 100 ft., formed with Portland cement walls, coped with blue Staffordshire coping, the floors being formed with cement concrete 12 in. thick.

The filters have the usual inlets fitted with disc valves, and the filtering material, averaging 2 ft. 6 in. in depth, is composed of a layer of 9 in. pipes, followed by gravel and sand of varying fineness, and finished with 3 in. of loam and sown down with grass.

The four low-level filters are constructed in a similar manner, but measure 107 ft. by 44 ft. 6 in. each, and the filtering material is only 15 in. thick.

The total area of these filters is $1\frac{1}{2}$ acres.

They have been in constant use since the Works were opened, and are only now having the surface soil cleaned and renovated.

The process of precipitation in use consists of first, a small dose of carbolic acid and iron salts mixed with the sewage as it enters the pump well.

After being pumped up the sewage receives the addition of a small quantity of milk of lime, approximately 4 or 5 grains per gallon, and afterwards about 7 grains per gallon of a mixture of sulphate of aluminous iron, &c.

The water, after leaving the tanks, is passed through the high-level or low-level filters and gravitates to the outlet channels, from whence it is discharged on the ebb tide into the river.

At high water, the surface of the water in the river is at a considerable height above the level of the water in the filters, and at such times the filtered water gravitates back by two 24 in. pipe drains to a pump well in the main building, from which it is lifted by two direct-acting steam pumps, capable of lifting 4,000,000 gallons in twenty-four hours, into a channel at a sufficient height for it to gravitate to the river.

The expense for chemicals per million gallons varies from time to time from 22s. to 25s. per million gallons.

Here follows a full account of the pumping machinery.

The concluding section of Mr. Fairley's instructive account is devoted to a description of the pressing plant, which is also given *in extenso*.

Originally three 36 in. sludge presses were erected in the pressing house, the pressing being done by means of hydraulic forcing engines. The system, however, had very serious disadvantages, and the maintenance was extremely heavy.

Recently three additional presses, embodying several improvements, have been fitted, and the opportunity taken of changing the whole system over from direct pumping to pressing by air pressure, one direct pumping engine, however, being still reserved as a stand-by in case of a breakdown, or anything going wrong with the air plant.

The whole of the plant, since its erection, has worked extremely well, and has fulfilled all the conditions that were required of it, the plates having been tested in an unusually severe manner, but without any breakages.

The new presses differ materially from those formerly put down. The opening and closing gear is a new pattern.

The plates, the breaking of which were the chief troubles formerly, were designed and specified to overcome the previous difficulties. The specification required a test pressure of 150 lb. on the one side of the plate only.

All the plates, both new and old, are fitted in the central orifice with a brass clip to secure the cloths. This device obviates any expense or trouble in sewing or preparing the cloths, nothing being necessary beyond punching out a hole in the centre of the canvas the required size.

The clip as first devised was not satisfactory, but by remedying the defects, a clip was at last modelled which gives little or no trouble.

The cost of pressing is as follows :—

				s.	d.
Labour	...	...	...	0	10
Lime	...	...	...	0	9
Cloths	...	...	...	0	4
Coal, oil, and stores	...	...	...	0	3
				<hr/>	<hr/>
				2	2
				<hr/>	<hr/>

The above is for ordinary work, but the output can be increased from 25 to 30 per cent. without increasing the total amount paid for labour in the day or week.

Large lantern lights have been fixed on the roof, and the sludge pit and sludge vats ventilated continuously into the chimney shafts by a steam exhauster worked by the exhaust from the engines.

The outfall to the river has been reconstructed, and is capable of discharging all the water pumped by the pumping machinery at high water.

Since 1891, the extensions, additions, new pumping and sludge-pressing machinery, &c., have been designed and carried out under Mr. Fairley's supervision as Engineer to the Board.

The annual amount of expenses for maintenance, repayment of capital, and payment of interest, is about £14,500.

The *Population* of the Richmond and Barnes Districts together amounts to nearly 50,000. Like that of Kingston and Surbiton combined, it is of a mixed character. But in the case of Richmond special care has been taken to keep out the brewery and trade refuse, which adds so much to the difficulties of purification. The quality of the sewage is further shown by the subjoined analyses.

Dry Weather Flow.—This varies from $2\frac{1}{2}$ to 3 millions gallons per day, according to the season of the year, while in wet weather, twelve times that quantity may have to be pumped, not of course throughout the whole day, but for the period during which the rain storm lasts.

[A notable feature about these Works is the use of Nitrifying beds in place of land for the further purification of the clarified effluent. In the case of the Kingston Works it will be observed that the assistance of land or Nitrifying beds in its place, is dispensed with altogether, but with questionable results.—C.M.O.H.]

CORPORATION OF KINGSTON-ON-THAMES. WORKS OF THE NATIVE GUANO COMPANY.

Established 1888. Surbiton included 1889.

SECRETARY, MR. STEVENS.

Situation and General Description of the Works.—These Works are situated not far from the market place. The Corporation of Kingston have been able to utilise the adjacent land as a riverside promenade. They consist of receiving and screening chambers, pump wells and channels, eight tanks for the precipitation of the sewage, and sludge well. There is also an ornamental building for the machinery and storage, and preparation of the chemicals, a small store room, an office and a shed for the finished product, called native guano.

The Kingston sewage, on reaching the Works, passes into the screening chamber and through a grating, which intercepts coarse matter likely to choke or injure the pumps, and thence through a culvert to a pump-well under the main building, where it receives the "B. C." or deodorising and purifying mixture. The sewage, thus partially treated, is raised about 12 ft. by centrifugal pumps, of which there are three, each driven by a 15 horse-power engine, and capable of lifting 1,650 gallons per minute.

The pumps discharge into a meter chamber, where the sewage is measured and the quantity registered. On leaving the meter, the sewage flows along an open channel to the settling tanks, receiving on its way the precipitating agents. There are eight tanks, each 85 ft. long by 50 ft. broad, and 6 ft. average working depth, holding 150,000 gallons, or 1,200,000 gallons in the aggregate, which gives a capacity of 30 gallons per head for a population of 40,000.

The treated sewage flows in a continuous stream through the tanks precipitating as it flows, and passes into a covered channel discharging into the Thames.

The tanks are cleaned periodically, the deposit or "sludge" being pumped into the sludge-well by a double-action pump, at the rate of 500 gallons per minute.

From this well, the sludge is first drawn into six sludge vessels, or accumulators, by the creation of a vacuum, and is then forced by air pressure, at 100 lb. on the square inch, into filter presses on the first floor of the building, from which it is removed in hard cakes. There are three air pumps, and sixteen filter presses.

The pressed cakes are dried in a drying cylinder (with fan and condensing apparatus attached), and ground into powder.

The Surbiton sewage is separately received and screened, and is pumped by centrifugal pumps, through a meter, into the Kingston pump-well. There are three pumps, each driven by an 8 horse-power engine, and capable of lifting 750 gallons per minute.

The boilers are of the locomotive multitubular type, working at a pressure of 150 lb. per square inch ; one of 80 horse-power, and two of 60 horse-power each.

The two main driving engines, each of 40 horse-power, are used alternately.

Two mortar mills are used for grinding the chemicals, which are then mixed in vats and discharged into the pump-well, and there are two vats for dissolving the precipitating agents.

A small centrifugal pump supplies water from the river for the boilers, mixing the chemicals, &c.

At present the sewage being treated is that of

Kingston, with a population of	33,279	} 1898-9
Surbiton " "	12,364	
Hampton Wick " "	2,924	
<hr/>		
Total ...	48,567	

Whole Area devoted to the Works.—This amounts to 3 acres.

Areas for Different Purposes (e.g., Buildings, Tanks, &c.).—Buildings, about 900 square yards; tanks, channels, &c., about 4500 square yards. Remainder of area roads, paths, gardens, provision for extension, &c.

General Account of the System adopted, Size of Tanks, &c.—The system adopted is the Native Guano Company's A. B. C. (alum, blood, carbon and clay) process of purification and utilisation. The tanks have a total capacity of 1,200,000 gallons.

Number and Character of Population.—The number of the population, including the 3000 of Hampton Wick, may be computed at about 48,000. The districts are chiefly residential, but in Kingston there is a considerable proportion of houses occupied by the artisan and wage-earning classes. Practically the whole district is water-closeted.

Character of Sewage.—This is mainly domestic, with the addition of brewery, tannery, and fellmongers' refuse, and also the waste liquors from gas works. It is not therefore the most easy sewage to purify.

Dry Weather Flow.—This is about $1\frac{1}{2}$ million gallons per day, or 30 gallons per head of the population.

Wet Weather Flow.—This is about 2,934,282 gallons per day. The total quantity pumped and treated in 1898, an abnormally dry year, was as follows:—629,107,017 gallons; average 1,723,580 gallons per day, or about $35\frac{1}{2}$ gallons per head of the population per day.

Effluent.—The effluent may be generally described as clear, colourless and odourless, and authorities such as Professor Dewar, Dr. Frankland, &c., have testified from samples submitted that it is of sufficient purity to be discharged into the Thames. A different degree of purity is required according to the situation of the town, one above the intakes of the Water Companies being required to produce a purer effluent than one below, entailing, of course, extra expense.

General Remarks.—The cost of the Works, complete with pumping machinery (exclusive of the cost of the land), was less than 10s. per head of the population.

They are worked by the Native Guano Company under contract for a fixed annual payment of a rate of three pence in the pound on the net

rateable value of property in Kingston, Surbiton, and Hampton Wick, with an extra one penny rate for treatment of the Kingston night sewage and a small additional payment for pumping. For these annual payments the Company undertake the entire treatment and disposal of the sewage, to produce a satisfactory effluent, and to carry on the operations without nuisance, and as security for their guarantee the Company have deposited the sum of £1000 Consols.

[The C.M.O.H. desires to add one or two remarks to the above, which consists mainly of a statement courteously furnished him by the Secretary of the Native Guano Company :

At various times during the past nine years he has cited these Works to illustrate very forcibly one point—viz., the possibility of conducting sewage works close to a large population. He has not, of course, quoted them as an example of good purification works ; they do not profess to do much more than clarify the sewage. And notwithstanding the opinion of the eminent professors above mentioned, the C.M.O.H. thinks that the “higher standard” of purification of the effluent may be reasonably required, especially in the summer, when the water may be low and the river is resorted to by so many for health and recreation. The higher standard referred to in the body of this Report might, at such season, be considered a legitimate demand. The complete Purification of the Night Sewage is also very important.

Furthermore, in regard to nuisance, although considering the position of the Works, it is remarkable how little offence they create, still it would not be correct to say that there are *never* any complaints. Such is not the case, and it is pretty certain that the Works have themselves occasionally been responsible for the creation of the nuisance. But in fairness to the Company it should be said that other businesses which may give rise to offensive effluvia are conducted close to the guano works. At any rate, there can be no doubt that the Kingston Corporation are acting wisely in maintaining a constant supervision of the Works through the department of the able Medical Officer of Health, to whom the effluents are submitted for examination at frequent intervals.]

